Town of Newmarket

186 Main Street
Newmarket, NH 03857

MASTER PLAN

CHAPTER 1
WATER RESOURCES CHAPTER

Prepared for the Town of Newmarket
By the Strafford Regional Planning Commission
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September 8, 2009

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The Water Resources Chapter was adopted by the Newmarket Planning Board on September 8, 2009

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The Town of Newmarket Planning Board thanks the Water Resources Chapter Work Group for its contributions, guidance and technical advice, which was invaluable to the development of this Chapter.

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EXECUTIVE SUMMARY

The current Water Resources Chapter of the Newmarket Master Plan was adopted in 2001. Since then Newmarket has undergone changes in the patterns and intensity of growth and land development as well as an overall population increase. Additionally, climate conditions over the last decade have produced record-breaking flood and storm events and periods of severe drought, resulting in environmental conditions that placed high demand on the Town's municipal water supply and the local aquifers.

Federal, state and other regional non-governmental partners continue to conduct significant research, inventories and analysis of water resources in the Coastal and Great Bay watersheds. These efforts have produced valuable scientific and environmental information about the status, health and viability of water resources and water-dependent resources in these watersheds. The results of these efforts have sparked much discussion about future management and sustainability of ecosystems, natural resource functions, human health, and drinking water supplies in coastal communities, including Newmarket.

For these reasons, the Town of Newmarket sought funding and assistance to update the existing Water Resources Chapter of the Master Plan by incorporating new information to better plan for the management and sustainability of the Town's water resources.

The protection and use of water resources are critical concerns to the Town of Newmarket. With virtually all residents dependent upon wells for domestic use, the quantity and quality of available groundwater must be protected from depletion and contamination. Other water resources, such as swamps, ponds, streams and wetlands, are important because they are hydrologically related to groundwater, and they provide ecological, scenic, and recreational value to residents and visitors.

In general, there is a direct relationship between land use and water quality. It is the responsibility of the Town to take reasonable and prudent precautions to protect all water resources from incompatible uses, thus protecting the health and general welfare of the community. Appropriate steps should be taken by the Town to insure that sufficient water supplies exist for use by Newmarket residents and businesses, as well as native wildlife and plant communities. The Town needs to examine and address water supply issues, watershed management, pollution, and potential aquifers/gravel areas.

Guidance for policies, regulations, and actions that affect Newmarket's water resources derives from the following water resources management objectives and conservation measures:

a. Protect public health, safety, and welfare
b. Maintain high environmental quality
c. Ensure that Town growth does not compromise (degrade) environmental quality
d. Direct development to environmentally suitable areas
e. Assure adequate water supply for residents and businesses

f. Preserve water quality and quantity for future residents and businesses
g. Educate residents and businesses about water resource issues
h. Participate in inter-municipal water resources management efforts
i. Comply with applicable local, state and federal regulations

This guidance was used to develop an overall vision statement and policy statements for each sector examined in the Water Resources Chapter.

Vision Statement
Vigorously protect water resources in Newmarket from contamination, depletion, alteration and degradation. Act as stewards for municipal and regional water supplies located within the Piscassic River, Lamprey River, Squamscott River and Great Bay watersheds.

Surface Waters Policy Statement
Provide for comprehensive protection of shorelands to protect the quality of surface waters through regulatory, educational and voluntary efforts. The loss of shoreland buffers through variances, waivers and through illegal activities should be minimized.

Wetlands Policy Statement
Implement comprehensive protection of wetlands, particularly prime wetlands, and their buffers through regulatory, educational and voluntary efforts. The loss and degradation of wetlands should be minimized in order to maintain the critical functions and values they provide.

Water Quality and Habitat Protection Policy Statement
Develop and implement policies, regulations and standards that ensure protection of water quality and wildlife habitat. These efforts should focus on land use, and conservation and management measures that ensure the sustainability of these resources.

Flood Plains and Flood Management Policy Statement
Implement regulatory, educational and voluntary measures to maintain the functions of flood plains and to minimize impacts of flooding on natural resources and damage to municipal and private property.

Groundwater Resources Policy Statement
Protect the volume and quality of groundwater resources for use as future sources of drinking water and to protect the hydrology of surface waters and wetlands.

Municipal Drinking Water Supply Policy Statement
Comprehensively protect existing and future drinking water sources and manage these resources to accommodate growth while sustaining them for the future.

Potential Threats to Water Resources Policy Statement
Protect water resources from pollution and degradation to maintain critical functions, benefits and ecological integrity of these resources.

Areas of Ecological Concern Policy Statement
Establish new and maintain existing local, regional, state and federal partnerships to prevent the loss of significant wildlife habitat and ecosystems by implementing regulatory, educational and

voluntary measures for land conservation, forest preservation, open space planning, and wise land use and growth.

Regional and Watershed Planning Policy Statement
In partnership with local, regional, state and federal partners, implement strategies to address sustainability of shared water, land and air resources.

Implementation
The final section of the chapter outlines specific recommendations for each sector of water resources, as well as an implementation plan for completing these actions. It is designed to guide policy-makers during their decision making process. The Water Resources Chapter Work Group and the Newmarket Planning Board derived the recommendations discussed.

The implementation plan incorporates each recommendation and places it within one of three timeframes. Short Term Actions would be implemented within the first 2 years. Intermediate Term tasks would be implemented within 2-5 years, and Long Term tasks are those considered for implementation in 5 years or longer.

The Implementation Plan assigns a management approach to each recommendation based on the scope of work to be completed, the activity type, and the products or tools that will result. Management approaches include:

- Public Education, Outreach and Training
- Land Use Regulation and Policy
- Land and Resource Conservation
- Resource Planning and Management
- State/Local Enforcement
- Collection and Use of Data
- Regional Watershed Coordination

Each recommendation is assigned a lead group, staff person or department to coordinate with partners, outside groups or agencies and to guide implementation.

Funding availability is critical to the success of the Implementation Plan. Sources of funding may be one time, annual, or other ongoing timeframe from a variety of local, state, federal and nonprofit sources. It is recommended that the Town develop a database of these funding sources. A work plan needs to be developed for each Implementation Action including a budget. Implementation Actions can be grouped according to water resource sector, goals and products for inclusion in grant proposals (i.e. stormwater, ordinance and regulation development, outreach and education, land conservation).

1-1 INTRODUCTION

A. Vision Statement

Vigorously protect water resources in Newmarket from contamination, depletion, alteration and degradation. Act as stewards for municipal and regional water supplies located within the Piscassic River, Lamprey River, Squamscott River and Great Bay watersheds.

The protection and use of water resources are critical concerns to the Town of Newmarket. With virtually all residents dependent upon wells for domestic use, the quantity and quality of available groundwater must be protected from depletion and contamination. Other Town water resources, such as swamps, ponds, streams, and wetlands are important because they are hydrologically related to groundwater, and provide ecological, scenic, and recreational value to residents.

In general, there is a direct relationship between land use and water quality. It is the responsibility of the Town to take reasonable and prudent precautions to protect all water resources from incompatible uses, thus protecting the health and general welfare of the community. Appropriate steps should be taken by the Town to insure that sufficient water supplies exist for use by Newmarket residents, as well as native wildlife and plant communities. The Town needs to examine and address water supply issues, watershed management, pollution, and potential aquifers/gravel areas.

Guidance for policies, regulations, and actions that affect Newmarket's water resources derives
from the following water resources management objectives and conservation measures.

a. *Protect public health, safety, and welfare*
b. *Maintain high environmental quality*
c. *Ensure that growth does not compromise (degrade) environmental quality*
d. *Direct development to environmentally suitable areas*
e. *Assure adequate water supply for residents*
f. *Preserve water quality and quantity for future residents*
g. *Educate residents about water resource issues*
h. *Participate in inter-municipal water resources management efforts*
i. *Comply with applicable local, state, and federal regulations*

B. Overview

Newmarket is a community of 9,080.3 acres or 14.2 square miles of land and water with an estimated population for 2008 of 9,243 persons. The Town has many acres and types of water resources, which are summarized in the table below. These resources provide valuable functions and services that benefit the public health and welfare and the environment.

The topography of Newmarket is gently rolling and elevations range from sea level along tidal areas to greater than 280 feet on Bald Hill in the westernmost area of town. Great Bay and the Lamprey River are the town's most significant waterbodies.

Table 1. Water Resources of Newmarket

Resource Type	Acreage	% Total Municipal Area
Freshwater Surface Waters	73.3	0.8
Coastal/Tidal Waters*	972.9	10.7
Streams and Rivers (miles)	24.6mi	NA
Freshwater Wetlands	896.3	9.9
Prime Wetlands*	1,091.0	12.0
Floodplain *	1,159.5	12.8
Stratified Drift Aquifer	657.5	7.2

*Includes portions of open water
[Sources: NH Hydrography Dataset. (2006), National Wetlands Inventory, US Fish & Wildlife Service. (2007), Federal Emergency Management Agency. (2006), US Geological Survey. (2000), Strafford Regional Planning Commission GIS database. (2009)]

Newmarket is positioned in the lowermost reaches of the Coastal Watershed, and within portions of the Lamprey River, Exeter River and the Great Bay watersheds. It contains both freshwater and tidal rivers and estuarine ecosystems. Tidal influence on the Lamprey River extends to Macallen Dam in downtown near the NH Route 108 crossing. Tidal influence of the Great Bay extends up Lubberland Creek and the Squamscott River, as well as several unnamed tributaries in the southern areas of town.

Drinking Water Supply
Drinking water sources are available in both stratified drift and bedrock aquifers. Currently, the Town relies on two groundwater wells located in the Newmarket Plains Aquifer for its municipal drinking water supply. However, the Town is currently conducting an investigation to identify new groundwater sources suitable for use as a drinking water supply to augment existing sources.

Flood Management
Flooding in New Hampshire often occurs as a result of heavy spring rains, runoff, ice jams, and coastal storms. Damage from flooding can be localized, but the cost of repairs is typically costly in both monetary terms and damage to public and private property. For these reasons, a floodplain management program is an important part of community land use planning.

Historically, flooding on streams and rivers in Newmarket generally occurs in the spring months from rapid runoff caused by seasonal rainstorms combined with snowmelt. Less frequently, flooding occurs in the late summer and fall as a result of hurricanes and other large storm events. Low-lying areas adjacent to the Great Bay and the tidal portions of local rivers and streams are subject to periodic flooding and are associated with extreme high tides and tidal surges from coastal storms. Significant tidal flooding occurred in February 1978 when New England experienced one of the most severe winter storms of record. However, the most severe flooding events have occurred in recent years during the spring storms of 2006 and 2007.[1]

Overall, flooding potential in Newmarket is high due to the combination of riverine systems and tidal portions of surface waters including the Great Bay. In addition, both seasonal flooding and flooding due to extreme weather events have the potential to occur during any time of year.

Conservation Efforts
As reported in the Newmarket Open Space Plan (2007), 1,866 acres or 20.56 percent of land in Newmarket is protected as public and private conservation lands, through public and private protective easements or as dedicated open space. Newmarket owns approximately 362.5 acres, the largest parcels being Wiggin Farm-Tuttle Swamp (160 acres), Tuttle Swamp (58.8 acres), the Kwaks property (57.34 acres), Piscassic River-Loiselle (45.3 acres), and Heron Point Sanctuary (30 acres). Other conservation landowners include the Great Bay Resource Protection Partnership (>600 acres), NH Fish and Game (242.4 acres), The Nature Conservancy (176.6), and Southeast Land Trust of New Hampshire (20.0). These town-owned and other conservation lands contain critical water resources including extensive wetlands, floodplain, streams and rivers, and riparian habitat.

C. Water Resource Chapter Update

The current Water Resources Chapter of the Newmarket Master Plan was adopted in 2001. Since that time, Newmarket has undergone changes in growth patterns, land development and increases in population. In addition, climate conditions in the past decade have produced periods of severe drought, which resulted in environmental conditions that placed high demand on the town's municipal water supply and the local aquifers.

Federal, state and other local non-governmental partners have also conducted significant research, inventories and evaluation of water resources in the Coastal and Great Bay watersheds. These efforts have produced valuable scientific and environmental information about the status, health and viability of water resources and water-dependent resources in these watersheds. The results of these efforts have sparked much discussion about future management and sustainability of ecosystems, natural resource functions and benefits, human health, and drinking water supplies in many communities, including Newmarket.

For these reasons, the Town of Newmarket sought funding and assistance to update the existing Water Resources Chapter of the Master Plan by incorporating new information to better plan for the management and sustainability of the town's water resources.

[1] Federal Emergency Management Agency, *Flood Insurance Study, Town of Newmarket, New Hampshire, Rockingham County*, 1991

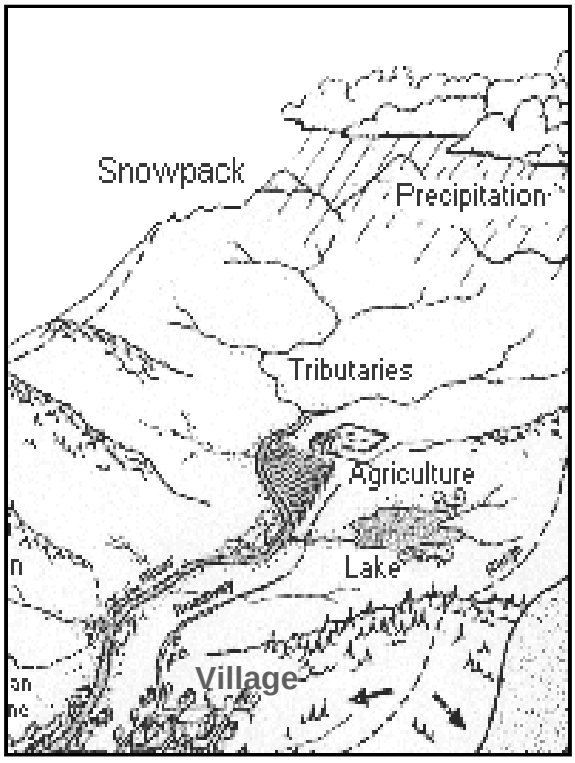
1-2 SURFACE WATERS

Policy Statement

Provide for comprehensive protection of shorelands to protect the quality of surface waters through regulatory, educational and voluntary efforts. The loss of shoreland buffers through variances, waivers and through illegal activities should be minimized.

A. What is a Watershed?

Everyone lives in a watershed - the land area that drains to a common channel or waterway, such as a stream, lake, estuary, wetland, aquifer, and the ocean are all considered watersheds. Ridges and hills that separate two watersheds are called the drainage divide. The term watershed is sometimes used interchangeably with the terms "drainage basin" or "catchment".



The watershed consists of surface water--lakes, streams, reservoirs, and wetlands--and all the underlying ground water. Larger watersheds contain many smaller watersheds. This means that every stream, brook, tributary, river, overland runoff and even some groundwater eventually reaches a larger body of water within its immediate watershed. [2]

The actions of an individual can directly affect the health of a watershed by altering drainage patterns and introducing pollutants such as sediment, nutrients and chemicals into surface water and groundwater.

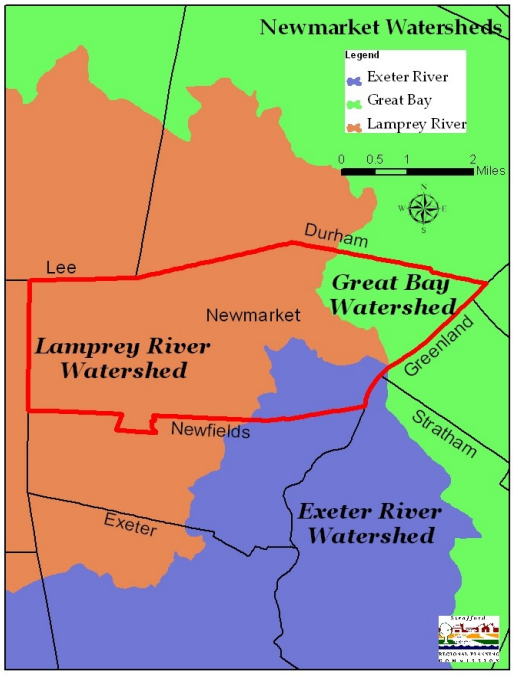
To learn more about your local watershed, refer to the EPA website "Surf Your Watershed" at http://cfpub.epa.gov/surf/locate/index.cfm.

[2] US Geological Survey, *Water Science for Schools*, http://ga.water.usgs.gov/edu/watershed.html, July 23, 2009.

B. Major Watersheds

As shown in Figure 2 and Table 2, the major watersheds of Newmarket and surrounding communities are the Lamprey River (including the Piscassic River and Lower Lamprey River subwatersheds), the Exeter River (including the Squamscott River subwatershed) and the Great Bay watersheds.

Figure 2. Major Watersheds of Newmarket – Lamprey River, Exeter River, and the Great Bay Watersheds



The principal rivers and surface waters in Newmarket include the Lamprey River, the Piscassic River, Follett's Brook, and the Great Bay Estuary.

As reported in Table 2 approximately 37 percent or 3,355 acres of land in Newmarket, including nearly the entire southern half of town west of Route 108, is contained within the Piscassic River subwatershed. The Lower Lamprey River is the second largest subwatershed consisting of 3,204 acres or 35 percent of the total land area of the town. The Great Bay Estuary and Squamscott River watersheds comprise the remaining 28 percent of the total land area, including most lands north and south of the confluence of the Lamprey River and Great Bay.

Table 2. Watersheds by USGS Hydrologic Unit Classification (HUC) Watersheds
[Source: U.S. Geological Survey]

HUC 10 Watersheds	HUC 12 Watersheds	Acres	% Total Municipal Area
Lamprey River Watershed (0106000307)	Piscassic River (010600030709)	3,354.9	37.0
	Lower Lamprey River (010600030708)	3,204.4	35.3
Great Bay Watershed (0106000309)	Great Bay Estuary (010600030904)	1,537.0	16.9
Exeter River Watershed (0106000308)	Squamscott River (010600030708)	984.1	10.8

Note: Hydrologic Unit Code (HUC). The U.S. Geological Survey (USGS) has divided and sub-divided the entire United States into successively smaller watershed hydrologic units. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of groups of two to eight digits or more based on the four levels of classification in the hydrologic unit system. Note in the table above, the 12 digit watersheds are subdivisions of the three larger ten-digit watersheds.)

C. Streams, Rivers, Lakes and Ponds

Streams and Rivers

Newmarket has a total of 24.6 linear miles of streams and rivers, including 23 miles of perennial creeks, streams and rivers and 1.6 miles of intermittent streams and creeks. Lakes, ponds and tidal rivers comprise 151.7 acres or 14.5 percent of the total water area of the town.

Table 3. Surface Water Bodies by Type and Acreage
[Source: NH Hydrography Dataset]

Surface Water	Acres	% Total Water Area
Lamprey River (Freshwater)	16.8	1.6
Lakes (Impoundments)	23.1	2.2
Ponds	33.4	3.2
Lamprey River (Tidal Portion)	95.2	9.1
Great Bay	877.7	83.9
Total	**1,046.2**	**100**

Stream Order

The streams occupying a watershed form a hierarchical network of channels that hold increasingly larger volumes of water as they flow toward the outlet of the watershed. A stream's order is its rank, or relative size, within the network. When diagramming stream order, scientists begin by identifying first-order streams – channels that have no tributaries. These first-order streams are usually at the upper reaches of the watershed (headwaters) and near its source. A second-order stream would form at the intersection of two first order streams. The joining of two-second order streams would form a third-order stream. Stream ranking continues in this manner until the highest-ordered channel is reached for that watershed. However, a first order stream joining a second order stream would not change anything. It is not until one stream combines with another stream of the same order that the resulting stream increases by an order of magnitude. As water travels from headwater streams toward the mouth or outlet of the watershed, the width, depth, and velocity of the waterways gradually increase, as well as the discharge volume. These physical characteristics define the types of aquatic organisms inhabiting a stream. Table 4 below shows Newmarket's streams by order and type.

Table 4. Stream Miles by Stream Order and Type
[Source: NH Hydrography Dataset]

Stream Order/Type	Miles	% Total Stream Miles
1st Order	12.3	49.8
2nd Order	4.7	19.0
3rd Order	0.7	2.9
4th Order	4.3	17.7
5th Order	NA	NA
6th Order	2.6	10.7
Perennial Streams	23.0	93.5
Intermittent Streams	1.6	6.5
Total Stream Miles	**24.6**	---

Public Waters Under the Jurisdiction of the Comprehensive Shoreland Protection Act (CSPA)
All lakes, ponds and impoundments 10 acres or greater in size, all 4th order and greater streams, all designated river segments under RSA 483 and all waters subject to the ebb and flow of the tide (including tidal marshes, rivers, and estuaries) fall under the jurisdiction of the CSPA. They are shown on the map on the following page. Table 5 lists the rivers and the tidal portion of the Lamprey River under the jurisdiction of the CSPA.
See list at http://des.nh.gov/organization/divisions/water/wetlands/cspa/water_bodies.htm.

Table 5. NH Department of Environmental Services List of Fourth Order and Higher Streams

River/Stream	Beginning of Fourth Order or Higher Segment
Lamprey River	At juncture of Nicholls Brook in Deerfield
Upper Narrows	At juncture of Lamprey River
Piscassic River	At juncture of unnamed 4th order stream in Fremont

Primary Headwater Streams

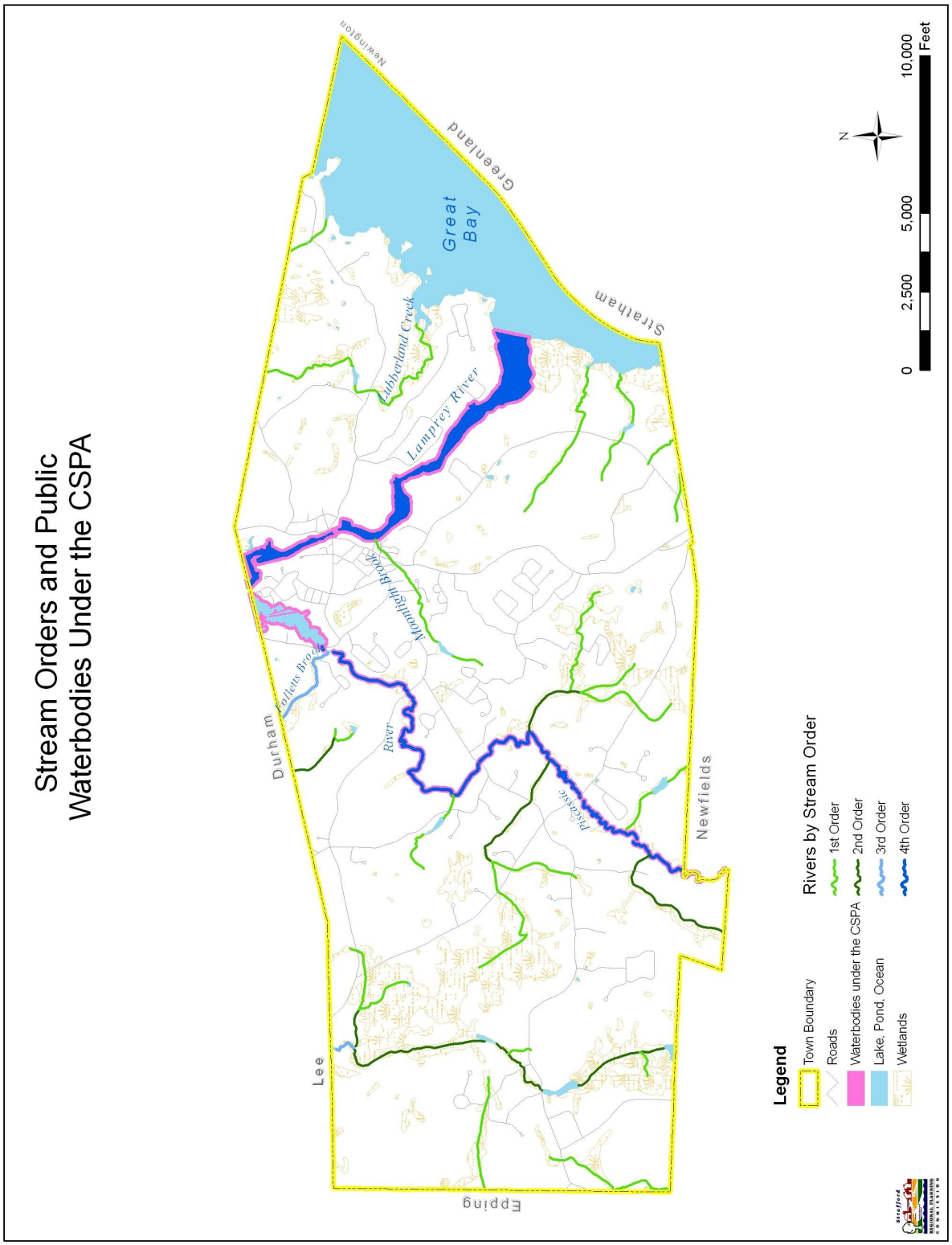
Headwater streams within a watershed area of less than one square mile are considered primary headwater streams, and can be ephemeral, intermittent or perennial. The health of larger streams, rivers, and other surface waters in the watershed depend upon an intact primary headwater stream network. Particularly, the stream network in the upper parts of the watershed greatly affects downstream water quality.

Headwater streams (first order streams) comprise nearly 50 percent of the total stream miles in Newmarket. Headwater streams are particularly important for maintaining water quality due to the significant percent of the total number of stream miles they represent in most watershed drainage systems. Primary headwater (first order) streams in Newmarket include:

- unnamed tributaries that drain directly to Great Bay and Lubberland Creek
- unnamed tributaries that drain from Tuttle Swamp
- unnamed tributaries that drain from wetlands southwest and northeast of Ash Swamp Road
- unnamed tributaries that drain east from Epping through wetland complexes located north and south of Grant Road

The importance and benefits provided by primary headwater streams include: reduction of sediment delivery downstream, reduction in nutrient loading (nitrogen and phosphorous), flood storage and control, and wildlife habitat corridors and aquatic habitat. The economic reasons to protect and improve primary headwater streams include: protection of public drinking water sources, maintenance of recreational uses of lakes, ponds and rivers, minimizing damage to infrastructure (bridges, culverts, dams) and property, and maintaining channel morphology and land stability.

Figure 3: Stream Orders and Public Waterbodies Under the CSPA



Lakes and Ponds

Newmarket's many small ponds and other unnamed surface water bodies are typically located within large wetland complexes in low lying areas through which rivers, streams, and small unnamed tributaries flow. These water bodies are interspersed through the subwatershed drainage systems including: Moonlight Brook, Lubberland Creek, Piscassic River, Follett's Brook and several of their unnamed tributaries.

D. Major Rivers and Great Bay Estuary

Lamprey River

The Lamprey River watershed, which includes the Piscassic River and Lower Lamprey River subwatersheds, comprises 6,559 acres or 7.2 percent of the total area of Newmarket. Appendix F: Lamprey River Watershed Map shows water resource features in Newmarket and surrounding communities in the Lamprey River watershed including public drinking water wells and associated wellhead protection areas, aquifers, dams, floodplains, wetlands, and surface waters.

The U.S. Geological Survey has collected discharge data for the Lamprey River from 1934 to the present at their gauge station located just north of the Newmarket boundary in Durham southwest of the intersection of Bennett Road and Packers Falls Road, as shown below.

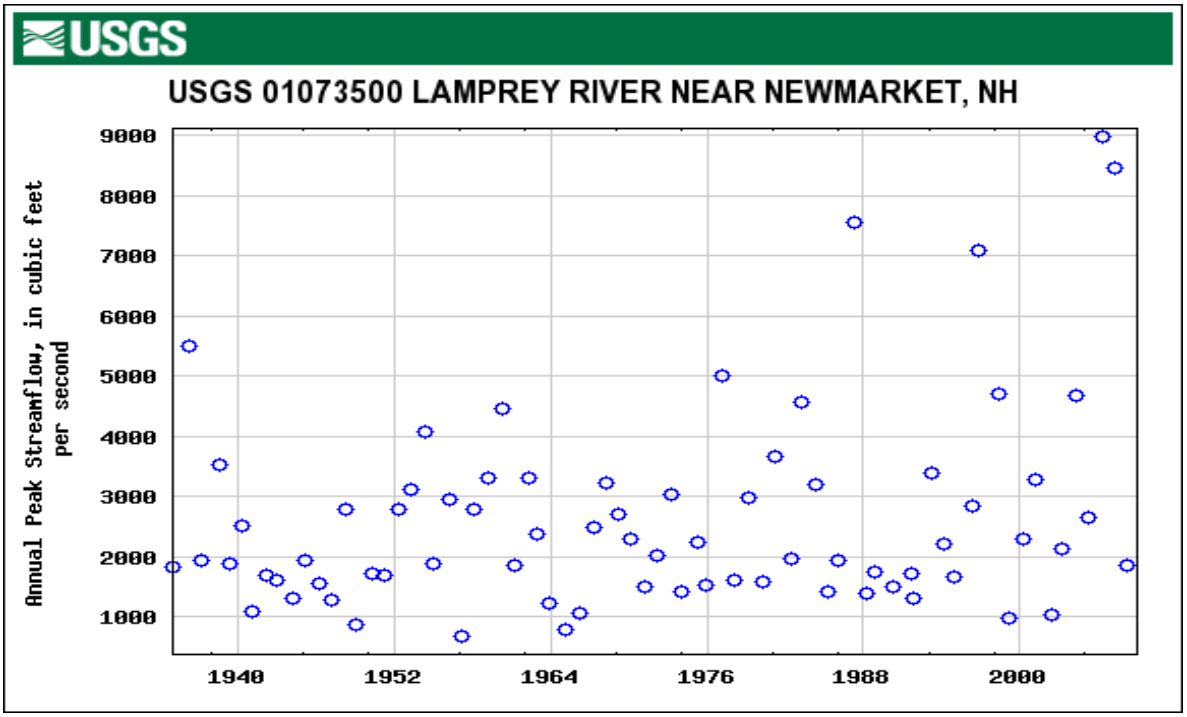


Figure 4. Annual Peak Discharge for the Lamprey River from 1934 to 2007 [Source: USGS Gage Station; Hydrologic Unit Code 01060003. Latitude 43 06'09", Longitude 70 57'11" NAD27; Gage Datum 38.28 feet above sea level NGVD29. Drainage Area 183 square miles]

The largest average annual peak flows (>4,000 cubic feet per second) are listed in Table 6 below. The three largest recorded annual peak flow events occurred between the periods from 1987 to 2007. This may be a result of alteration of drainage paths due to increased development in the Lamprey River watershed and higher than normal rain events.

Table 6. Annual Peak Discharges >4,000 Cubic Feet per Second for the Lamprey River for the Periods from 1936 to 2006

Year	Date	Discharge (cfs)
1936	March 20	5,490
1954	May 11	4,070
1960	April 6	4,470
1977	March 15	5,000
1983	March 20	4,570
1987	April 7	7,570
1997	October 22	7,080
1998	June 15	4,720
2004	April 3	4,690
2006	May 16	8,970
2007	April 18	8,450

Highlighted are the 2006 and 2007 spring storms.

New Hampshire Designated River

In 1990, the section of the Lamprey River in Lee and Durham was designated under the New Hampshire River Management and Protection Program (RMPP). The Lamprey River's "Rural River" segment designation reflects the relatively unaltered condition of the landscape and the modest level of development that existed within the river corridor (land within one quarter mile from the river bank) at the time of designation. Generally, Rural Rivers are adjacent to lands, that are partially or predominantly used for agriculture, forest management, and dispersed or clustered residential development. Some instream structures may exist, including low dams, diversion works and other minor modifications but the river flow is for the most part unobstructed. As part of the Lamprey River's designation, the Lamprey River Local Advisory Committee was established to ensure protection of the river under the New Hampshire River Management and Protection Program. As a fourth order or higher river, the entire mainstem of the Lamprey River in Newmarket is regulated under the Comprehensive Shoreland Protection Act (CSPA). New requirements of the revised CSPA took affect on July 1, 2008.

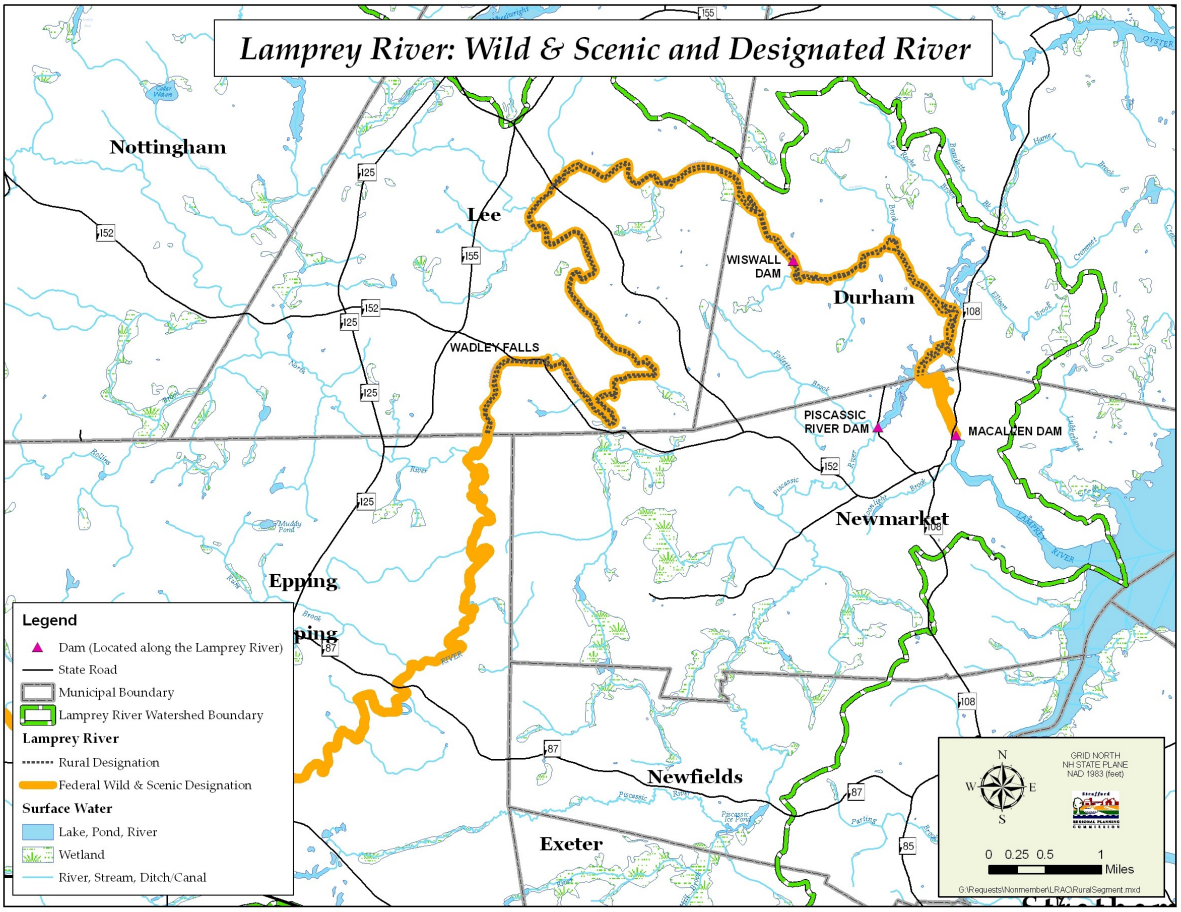
Wild and Scenic River

In 1996, Congress designated an 11.5-mile segment of the Lamprey River in Lee, Durham, and part of Newmarket under the federal Wild and Scenic River program (See Figure 5). This was followed in 2000 with designation of 12 additional river miles in Epping. The Wild and Scenic Rivers Program provides that certain selected rivers and their immediate environments that possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values, shall be preserved in a free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations (Wild and Scenic Rivers Act, October 2, 1968). The Act purposefully strives to balance river development with permanent protection for the country's most outstanding free-

flowing rivers. To accomplish this, the Act prohibits federal support for actions, such as the construction of dams or other instream activities that diminish the river's free flow or outstanding resource values. The Act specifically:

- Prohibits dams and other federally assisted water resources projects that would adversely affect river values;
- Protects outstanding natural, cultural, or recreational values;
- Ensures water quality is maintained; and
- Requires the creation of a comprehensive river management plan that addresses resource protection, development of lands and facilities, user capacities, and other management practices necessary to achieve purposes of the Act.

Figure 5. Wild & Scenic Portion and Rural Designated Segment of Lamprey River



Historical Importance

From the time its flow was first harnessed to power the grist and saw mills that began developing along its banks in the mid-1600s, the Lamprey River has always been a central cultural and natural resource feature for Newmarket. The Macallen Dam, located within the mill complex along Main Street, separates the tidal portion of the river from the freshwater flow. The average flow is about 19 cubic feet per second (cfs) and, historically, has ranged from a high of more than 2,500 cfs to a low of 1 cfs. The entire drainage area consists of about 212 square miles with its headwaters originating beyond the municipal boundaries of Newmarket in Deerfield. Today,

the Lamprey River supports a variety of recreational uses including boating, fishing, swimming in certain areas, and ice fishing and skating in the winter. It is considered to have significant ecological value, supporting some of the most important anadromous fishery habitat in the state, as well as providing aquatic habitat for numerous wildlife and waterfowl species. The lower Lamprey River represents a major access point for boaters and other recreational enthusiasts using the Great Bay.

Lamprey River In-Stream Flow Pilot Project
The New Hampshire Department of Environmental Services (NHDES) is currently in the process of adopting instream flow regulations for the Lamprey River that would restrict water withdrawals during low flow conditions in river segments currently designated under the NH River Management and Protection Act. Neither the Piscassic River nor the lower portions of the Lamprey River in Newmarket are currently designated for protection under this program. Water is withdrawn from the Lamprey River, just above Wiswall Dam, for use as a secondary drinking water supply for the Town of Durham and the University of New Hampshire. This water intake is located within a designated river segment of the Lamprey River corridor. Such withdrawals will likely be evaluated as part of implementation of the instream flow regulations for the river.

Piscassic River
The Piscassic River is a major tributary to the Lamprey River and flows northerly out of Newfields through much of the area around Ash Swamp Road, Grant Road and Lang's Lane. The river then flows beneath Route 152, spills over the dam at Packers Falls Road and then joins up with the Lamprey River about one half mile downstream. The lower Piscassic River, below the dam at the former Water Treatment Plant on Packers Falls Road, is often mistakenly considered to be part of the Lamprey River because it is an extension of the impounded waters behind the Macallen Dam that is located downstream on the Lamprey River. The confluence with the Lamprey River is actually located just north of the Durham and Newmarket town boundary.

Follett's Brook
Follett's Brook flows southeasterly from Durham and joins up with the Piscassic River just above the Packers Falls Road dam. Only the lower third of Follett's Brook watershed is within Newmarket. Prior to 1990, Follett's Brook was used as the principal municipal water supply source with treatment provided at the Packers Falls Road Water Treatment Plant. The Piscassic River was used as a backup water supply source. In the last ten years, the Town has principally relied on groundwater from its two municipal wells.

Great Bay
Much of the eastern portion of town (i.e., east of Route 108) drains toward Great Bay or the tidal portion of the Lamprey River. Lubberland Creek, which runs under Bay Road, is one of several smaller tributaries that drain directly to the Great Bay. Lubberland Creek originates in wetlands along Dame Road in Durham and then drains southerly crossing beneath Bay Road and enters the Great Bay along the north side of Moody Point. The lower portions of the Creek contain extensive salt and freshwater wetlands. Much of the watershed associated with this drainage system remains as either open fields and forested areas with sparsely located homes, including a portion of a new residential subdivision off Dame Road, referred to as Gonet Drive.

The small tributaries to Great Bay should be included in the planning process to ensure protection of water quality of Great Bay. The Great Bay Protection Partnership Program, the Piscataqua Region Estuaries Partnership, and The Nature Conservancy regard undeveloped shoreline areas around Great Bay as high priority areas for habitat and water quality protection. The Conservancy has recently acquired conservation easements on several parcels along Lubberland Creek and continues to seek other easements on other parcels.

Perennial Streams
There are two relatively significant unnamed perennial streams that originate behind the Newmarket self-storage facility off Route 108 (aka Beaudet Farm) and flow easterly crossing beneath New Road and into Great Bay. Currently, the existing land use within the watersheds of these two small tributaries consists of open fallow fields and wooded areas. This area includes the Beaudet farm parcel which contains about 162 acres located in the Business (B-2) zoning district (also known as the "Black Bear" Tax Increment Financing (TIF) district), which represents one of the largest commercially zoned parcels in town. Several large, undeveloped parcels exist along New Road. These lands currently provide valuable aesthetic views of the Bay and extensive wildlife habitat. As the town continues to grow, these open lands could be developed. If these lands are developed in the future, the town might consider adopting specific conservation measures to preserve the natural features and wildlife habitat.

E. Fishery

Diadromous fish species continue to migrate between salt and fresh water through fish ladders on Great Bay's seven rivers, but habitat conditions have been altered over the course of centuries of river use. Historically, the following species were prevalent in the tributaries of and in Great Bay: Atlantic salmon (*Salmo salar*), Atlantic sturgeon (*Acipenser oxyrhynchus*), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), American shad (*Alosa sapidissima*), rainbow smelt (*Osmerus mordax*), and American eel (*Anguilla rostrata*). Some species are now either locally extinct (*e.g.,* salmon and sturgeon), showing declining trends (*e.g.,* rainbow smelt), or at low levels (*e.g.,* shad and eel) within the Great Bay estuary. Predation, competition and other ecological interactions have had significant effects on the entire estuarine plant and animal community. It is important to note that these species are associated with the region's cultural heritage and the viability of today's fishing and seafood industries. Today, Alewife, Blueback

Herring, American Eel, and Rainbow Smelt are present in Newmarket, and American Shad and Atlantic salmon are likely to be present.[3]

Diadromous fish habitat restoration is particularly effective when a combination of methods is applied that address multiple stressors that affect the health of salt marshes today. These methods are described in the table below.

Table 7. Fish Habitat Restoration Methods[4]

Method	Description
Dam Removal	Dam removal involves the removal or breach of an instream structure that diverts or impounds water. In addition to restoring fish passage to upstream areas, dam removal can increase fish habitat quality by restoring water flows, and in turn, sediment and nutrient flow, and is a permanent restoration that will not require ongoing maintenance or attention.
Nature-Like Fishways	Nature-like fishways (NLF) have been constructed in Europe, Canada, Australia, and Japan and have recently become more accepted as a dam removal alternative in the United States. Each NLF is carefully designed to mimic the natural conditions in the river reach that has been blocked. Successfully designed and constructed NLF can pass most or all naturally occurring species and provide good quality stream habitat for the plants and invertebrates that help to support fish.
Fish Ladder	A fish ladder is a series of ascending pools or steps with flowing water that allows some fish species to pass over barriers such as dams. Installation of fish ladders is an alternative restoration option when barrier removal is not feasible.
Fish Lift	A fish lift is an elevator-like mechanism where fish are attracted by species-specific water flows and are mechanically lifted up and released over a structure. Fish lifts can potentially accommodate all fish species and are most effective in bringing fish over very large structures such as large hydroelectric dams.
Culvert Enhancement or Replacement	Scientists and resource managers are increasingly looking at culverts as a source of stream habitat fragmentation. New Hampshire is currently conducting the first comprehensive watershed-scale assessment of the impacts of culverts on stream habitat continuity in the Ashuelot River watershed (located in southwestern New Hampshire), so there is now well-developed methodology for field assessment and analysis that could be applied to Great Bay tributaries.
Stocking	Fish stocking involves the release of adult and juvenile fishes into a river targeted for restoration. Fish may be captured and transported from rivers supporting healthy populations, or may be trapped in the lower reaches of a river and moved above an impoundment. Fish may also be hatchery produced and introduced into the target river in the juvenile stage.
Habitat Restoration	Habitat restoration involves improvements to water and substrate quality, including: shoreland buffer restoration to address runoff

[3] Jay Odell, Peter Ingraham, Alyson Eberhardt, Dr. David Burdick, *Great Bay Estuary Restoration Compendium (2006)*, Piscataqua Region Estuaries Partnership Publications http://www.nhep.unh.edu/resources/pdf/great_bay_restoration-tnc-06.pdf, pages 35-36, July 23, 2009.

[4] *ibid*., pages 37-39.

	and erosion issues, storm water runoff treatment to improve water quality, and restoration of stream channel morphology to increase floodplain habitat. These improvements promote the long-term re-establishment of fish populations, and address the overall ecological health of a system and therefore, will benefit many species in addition to the target species.

F. Local Requirements for Shorelands

The Newmarket Zoning Ordinance contains two overlay districts that protect surface waters and wetlands by restricting development and land disturbance near them, as found in Section 5.02 Shoreline Protection Overlay District and Section 5.03 Wetland Protection Overlay District. Because much of Newmarket's wetlands are contiguous with surface water systems, these ordinances work together to provide water quality protections for both resources. Refer to Section 1-3.D. for zoning requirements for the Wetland Protection Overlay District.

Shorelands
The requirements of the Shoreline Protection Overlay District apply to land within 125 feet from the reference line of Great Bay, Lamprey River, Piscassic River and Follett's Brook. Although the ordinance incorporates by reference the requirements of the state's Comprehensive Shoreland Protection Act (CSPA), it includes provisions that now are inconsistent with the 2008 revisions. For example, footnote 3 in Table 8 is one such inconsistency.

Table 8. Requirements of the Newmarket Shoreline Protection Overlay District, Section 5.02

Provisions of the Shoreland Protection Overlay District	Structure Setback (feet)	Area Limited Activity (feet)[1]	Buffer (feet)[2]
All Other Base Zoning Districts	125	125[3]	none
M-1 District	no minimum	125[3]	none
M-2 District (not applicable to marinas and their accessory structures)	50	125[3]	none

[1] Area of Limited Activity means some removal of vegetation or land disturbance is permitted.
[2] Buffer refers to an area of land where disturbance to vegetation or land is prohibited.
[3] Within the Shoreland Protection Overlay District not more than a maximum of 50 percent of the basal area of trees, and a maximum of 50 percent of the total number of saplings, shall be removed for any purpose in a 20-year period. A healthy, well-distributed stand of trees, saplings, shrubs and ground cover and their living, undamaged root systems shall be left in place.

G. Comprehensive Shoreland Protection Act (CSPA)

The NH Comprehensive Shoreland Protection Act (CSPA) applies to public waters (as defined in RSA 483-B) including tidal waters (all waters subject to the ebb and flow of the tide), lakes and ponds on the NHDES Official List of Public Waters, designated rivers and river segments, fourth order and higher streams and rivers.
The CSPA applies to the following water bodies in Newmarket[5]:

- Tidal waters including Great Bay, Lamprey River and Lubberland Creek

[5] NH Department of Environmental Services, *Official List of Public Waters*, NHDES Water Division: Dam Bureau, http://www.des.state.nh.us/cspa/coastal_waters.htm, July 23, 2009.

- Lamprey River impoundment above the Macallen Dam
- Non-tidal portion of the Lamprey River
- Piscassic River
- Upper Narrows (from the juncture of the Lamprey River)

Based on an evaluation of the existing Newmarket Shoreline Protection Overlay District ordinance for compliance with revised state statutes, the following revisions to Section 5.02 of the Newmarket Zoning Ordinance are recommended:

1. Section 5.02 (C)
    - Revise list of public waters covered by the CSPA.
    - Clarify the status of the Lamprey River as jurisdictional under the CSPA because it is a fourth order river.
2. Section 5.02 (D)(1)
    - Replace this paragraph with language from the CSPA or state that removal of vegetation within the District (within 125 feet of the reference line of Great Bay, the Lamprey River, the Piscassic River and Follett's Brook) shall be consistent with the requirements for clearing of vegetation as stated in the CSPA.

3. Section 5.02
    - Add CSPA language, but consistent with ordinance of 150' setback.

Note: The ordinance language pertaining to any shoreland that is jurisdictional under the CSPA must be at least as stringent as the requirements of the CSPA. The town may choose to adopt stricter standards than those required by the CSPA.

1-3 WETLANDS

Policy Statement

Implement comprehensive protection of wetlands, particularly prime wetlands, and their buffers through regulatory, educational and voluntary efforts. The loss and degradation of wetlands should be minimized in order to maintain the critical functions and values they provide.

A. Overview of Wetlands

The U.S. Fish & Wildlife Service defines wetlands as:

"lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of the year."[6]

A wetland is defined by presence of the three "H's":

- **H**ydrophytes - vegetation specifically adapted to wet conditions, to grow partly or wholly in water;
- **H**ydrology - level of groundwater and surface water within the soil profile or at the intersecting land surface; and
- **H**ydric soils - formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper horizons.

Wetlands are important for removing excess nutrients and sediment from the water, slowing and storing floodwaters, promoting groundwater infiltration, and providing habitat for a variety of vegetation and wildlife. In addition, wetlands provide recreational, educational and research opportunities. Vernal pools are a special type of wetland that typically dry out in the summer, have no fish population, and are especially valuable for amphibian reproduction.

The National Wetlands Inventory (NWI) of the U.S. Fish & Wildlife Service produces information on the characteristics, extent, and status of the Nation's wetlands and deepwater habitats. The five major kinds of wetlands are: 1) freshwater (or palustrine), 2) saltwater (or estuarine), 3) riverine, 4) lacustrine (or lakes and other deepwater habitats), and 5) marine

[6] Lewis M. Cowardin, Virginia Carter, Francis C. Golet, and Edward T. LaRoe, *Classification of Wetlands and Deepwater Habitats of the United States*, US Geological Survey: Northern Prairie Wildlife Research Center, http://www.npwrc.usgs.gov/resource/wetlands/classwet/index.htm, July 23, 2009.

wetlands. For NWI analysis and reporting purposes, these types of wetlands are further divided into subcategories based on their hydrologic regime and dominant vegetation type or community (such as freshwater forested wetland, freshwater emergent wetland, estuarine and marine intertidal wetlands).[7]

B. Newmarket's Wetlands

Wetlands identified by the U.S. Fish & Wildlife Service, National Wetlands Inventory (NWI) are summarized in Table 9 below by major wetland type and acreage. Wetlands are also shown on Appendix G - Water Resources Map. The total area of NWI wetlands mapped in Newmarket is 2,167 acres or nearly 24% of the Town's total area.

Table 9. Wetlands and Hydric Soils by Type and Acreage
[Sources: National Wetlands Inventory, US Fish and Wildlife Service. (2007), Rockingham County Soil Survey, US Dept. of Agriculture. (1994)]

Wetland Type*	Acres	% Total Municipal Area
Lacustrine	23.4	0.3
Marine	364.1	4.0
Riverine	828.1	9.1
Palustrine	951.8	10.5
Total	**2,167.4**	**23.9**
Very Poorly Drained (Hydric A)	781.3	8.6
Poorly Drained (Hydric B)	1,557.4	17.2

*Includes portions of open water

A large wetland area, known locally as Tuttle Swamp, extends from Lee into Newmarket along the western side of Ash Swamp Road with a smaller area on the eastern side of Ash Swamp Road. This wetland is considered to be a major groundwater discharge area that receives drainage from the surrounding upland areas. The northern half of Tuttle Swamp discharges to the Lamprey River in Lee while the southern half and eastern areas of the wetland system discharge to the Piscassic River.

In addition to Tuttle Swamp, there are extensive wetlands within the Piscassic River and Follett's Brook drainage areas. These wetlands provide for flood control during high flow periods. Other wetland areas of note include the extensive salt marshes along the Great Bay shoreline near New Road and in the north near Lubberland Creek. Wetland areas are delineated primarily by the soil classification and by the presence of either very poorly drained soils (Hydric A soils) or poorly drained soils (Hydric B soils). Aside from water-related issues, these wetlands provide an extensive network of habitat for a variety of flora and fauna.

Recreational and Educational Opportunities
Many conserved lands and open space lands in Newmarket provide public access through walking trails that pass through or have views of wetlands, streams and rivers. These trails provide the public with a unique opportunity to observe local wildlife and learn about wetland

[7] US Fish & Wildlife Service, *National Wetlands Inventory*, http://www.fws.gov/nwi/index.html, July 23, 2009.

functions, vegetation and seasonal changes that transform these ecosystems. Public walking trails are currently accessible at Wiggin Farm-Tuttle Swamp Conservation Area, Tuttle Swamp Conservation Area (north end), Piscassic River-Loiselle Conservation Area, Sliding Rock Conservation Area (and Piscassic Street Boat Launch), Riverbend Conservation Area, Follett's Brook Conservation Area (Trotter Park), Heron Point Sanctuary, and Lubberland Creek Preserve.

C. Wetland Habitats

Salt Marsh

Salt marshes (*Spartina patens* and *Spartina alterniflora*) are intertidal wetlands typically located in low energy environments such as estuaries. They exist both as expansive meadow marshes and as narrow fringing marshes along shorelines. Salt marshes are considered one of the most productive ecosystems in the world due to high rates of plant growth. Salt marshes provide important ecological functions, including shoreline stabilization, wildlife habitat, and nutrient cycling, and serve as important breeding, refuge and forage habitats for many species of crustaceans and other invertebrates, and fish.

Salt marshes are important components of the food web base that support all estuarine invertebrates, fish, and birds, and provide important, often essential habitat for hundreds of other species. The ecological services provided by eelgrass and salt marshes include protection from shoreline erosion, nutrient and sediment trapping, and pollution filtration. Salt marshes are a scarce habitat type, occupying only about 0.1% of the land area of New Hampshire.

Historically, salt marshes were first ditched and drained for salt marsh hay farms and later for mosquito control. In some communities, shoreland development for roadways, homes, and industry resulted in extensive dredging and filling of salt marshes in the past. As scientific study has increased understanding of salt marsh functions, efforts have increased to conserve and restore these habitats. Although wetland regulations have reduced many impacts, salt marshes continue to be degraded and destroyed as coastal development persists. Current threats to salt marshes include reduced tidal flow due to undersized culverts under roadways and train beds, loss of the upland buffer due to coastal development, excess nutrient inputs from stormwater runoff, and colonization by invasive species.[8]

[8] Jay Odell, Peter Ingraham, Alyson Eberhardt, Dr. David Burdick, *Great Bay Estuary Restoration Compendium (2006)*, Piscataqua Region Estuaries Partnership Publications http://www.nhep.unh.edu/resources/pdf/great_bay_restoration-tnc-06.pdf, page 11, July 23, 2009.

Salt marsh restoration is particularly effective when a combination of methods is applied that address multiple stressors that influence the health of salt marshes under current conditions.

These methods are described in Table 10 (on the following page).

Table 10. Salt Marsh Restoration Methods[9]

Method	Description
Hydrologic	To restore the health and function of marshes that are not providing important functions as a result of tidal restrictions, culverts large enough to support flow of the full tidal range can be installed to facilitate tidal flow. Hydrologic restoration can be an extremely effective method of restoring salt marshes because it addresses overall marsh function. Response to restoration is evidenced quickly by increased saltwater and sediment inputs, increases in salt marsh vegetation, and decreases in invasive plant species.
Excavation of Fill	Marshes have been filled by coastal development and disposal of dredge materials, and associated with transportation corridors (roads and railroads) and berms built to convert salt marsh to fresh water ponds. Excavation is effective for lowering the elevation of marshes to ensure adequate tidal inundation. It is also an effective method for removing invasive species such as *Phragmites australis* (common reed).
Open Marsh Water Management	Two periods of ditching salt marshes have caused most of our larger marshes to be unnaturally drained. From European settlement until about 100 years ago, small ditches were created in marshes to facilitate harvest and enhance the growth of salt hay.
Invasive Plant Removal	Factors such as reduced tidal flow and increased stormwater runoff have resulted in the colonization of salt marshes in New Hampshire by invasive, exotic species such as *P. australis* and *Lythrum salicaria* (purple loosestrife). A combination of methods has been found to be most effective at removing invasive species and restoring salt marsh vegetation. These methods include m*owing*, *a*pplication of *herbicide*, and r*eplanting* of native salt marsh vegetation.
Erosion Controls	Salt marshes exist as a dynamic balance between erosion and marsh building. When erosion exceeds marsh building, marsh loss occurs. The placement of barriers such as filtration enhancement devices seaward of salt marsh edges can reduce exposure and aid sediment accretion by reducing re-suspension of sediments. These devices are cost effective, easily constructed, and biodegradable; however, they often require maintenance and annual reconstruction.

Prime Wetlands

Designation of Prime Wetlands

Prime wetlands are designated by a municipality according to the requirements of RSA 482-A: 15 and Chapter Env-Wt 700 of the NH Department of Environmental Services (DES) administrative rules. The municipality initiates evaluation of wetlands within its boundaries for consideration as prime wetlands. The municipality evaluates the functions and values of the identified wetlands, typically using the *Method for Comparative Evaluation of Nontidal Wetlands in New Hampshire* (1991) or *Method for the Evaluation and Inventory of Vegetated Tidal Marshes in New Hampshire (Coastal Method)* (1993). Both field evaluation and remote (GIS) data are often used for the evaluation process. Once the municipality has selected wetlands to designate as prime, the municipality holds a public hearing before the vote on the designation. When approved for designation as prime wetlands, the municipality provides to DES Wetlands Bureau a copy of the study and tax maps with the designated prime wetlands identified. DES will review the submission from the municipality to ensure that it is complete and in accordance with

[9] *ibid*., pages 12-14

Env-Wt 702.03. When the submission is considered complete, DES will apply to any future projects that are in or within 100 feet of a prime wetland the rules and law that are applicable. All projects that are in or within 100 feet of a prime wetland are classified as major projects. All major projects require a field inspection by DES and all prime wetland projects require a public hearing to be conducted by DES. Twenty-six municipalities in New Hampshire, including Newmarket, have designated prime wetlands in their communities.[10]

Newmarket's Prime Wetlands

A study, conducted by West Environmental, Inc. titled *Newmarket Prime Wetland Designation Study* (2003), identified wetlands for prime designation. Based on the recommendations from this study, the NHDES approved designation of prime wetlands in Newmarket in November 2006. Newmarket's prime wetlands are shown on Appendix H - Wetlands Map and Table 11. below.

Table 11. Prime Wetland Candidates as Identified in Newmarket Prime Wetland Designation Study (January 28, 2003 by West Environmental, Inc.)

Wetland I.D.	Wetland Name	Acreage	Description
NE-01	Lamprey River East	45	Open water system high value fish and wildlife habitat, recreation area
NE-02	*Follett's Brook* **This wetland was not included for prime designation*		*Diverse stream system, high function and important tributary to the Piscassic River*
NE-03	Bay Road Interior	35	Large beaver impoundment, high wildlife habitat function, migratory waterfowl
NE-04	Lubberland Creek (north side of Bay Road)	45	High function stream system, tributary stream to Great Bay Estuary
NE-06	Piscassic River East	33	Riverine floodplain system, water quality and flood storage functions, fish habitat, wildlife corridor
NE—07	Town Center Wetland	8	Wildlife refuge
NW-01	Tuttle Swamp	346	Largest wetland studied, rare plant and animal species
NW-04	Newmarket Plains	19	High diversity and function, small size
NW-05	Nostrom Farm	56	Unique wet meadow, scrub-shrub swamp habitat, high ecological integrity; drains to Tuttle Swamp
SW-01	Bald Hill Road Marsh	110	Largest marsh in town providing high function and value, connects with Tuttle Swamp
SW-02	Ash Swamp Road South	66	Scrub-shrub swamp with high ecological integrity and shoreline stabilization
SW-03	Piscassic River West	113	Scrub-shrub riverine floodplain wetland, critical flood storage and water quality, fishing and wildlife habitat
SW-04	Neal Mill Road Wetland	39	High quality wildlife habitat, important tributary to the Piscassic River
SW-06	Hamel Farm Road Pond	16	Open water marsh, waterfowl habitat, important tributary to the Piscassic River
SE-01	Ash Swamp Road North	137	Red maple swamp, excellent diversity, high function and value, drains to Piscassic River

[10] NH Department of Environmental Services, NHDES Water Division: Wetlands Bureau, http://des.nh.gov/organization/divisions/water/wetlands/index.htm, July 23, 2009.

SE-02	Piscassic River Central	23	Forested riverine floodplain, critical link to other prime wetlands, high water quality and floor storage function, fish and wildlife corridor
Total Acres	**1,091**		

Vernal Pools

Vernal pools are temporary bodies of water that flood each year for a limited time during wet months, typically early spring to mid- or late summer months. Their common characteristics are the absence of fish, temporary flooding regime, and the presence of vernal pool species. The hydrology of vernal pools is maintained primarily by runoff from melting snow and precipitation, and in some cases groundwater flow. Vernal pools usually dry up by mid to late summer, depending upon climate factors such as the amount of rain and temperature. Some deep pools may remain flooded for a few years, especially when there is groundwater contribution, but become completely dry in seasons with very low rainfall. Autumnal pools fill during the fall with rising groundwater. Vernal pools vary in size, ranging from several square feet to several acres. They can be found in a variety of landscapes, such as isolated depressions in forests or meadows, kettle holes, and gravel pits. Many pools are contained within larger wetland complexes, oxbows in river floodplains and pools in forested swamps or scrub-shrub wetlands. To support life, vernal pools must have enough leaf litter and other debris to provide food sources and cover for the species that breed in them. Because vernal pools are not permanently flooded and do not support fish populations, they provide safe breeding sites for various amphibian and invertebrate species, including wood frogs, spotted salamanders, and fairy shrimp. These species depend upon the hydrology of temporary pools for specific phases of their life cycle. One easy way to locate vernal pools is to listen for wood frog choruses, which are groups of males singing to attract females.[11]

Vernal Pool Species
Species typically found in vernal pools in New Hampshire include: Wood Frog, Spring Peeper, green Frog or Bullfrog, Spotted Salamander, Jefferson Salamander, Blue-spotted Salamander, Marbled Salamander, Eastern Spotted Newt, Four-toed Salamander, Fairy Shrimp, Spotted Turtle, Blanding's Turtle and Wood Turtle.[12] Except for the Marbled Salamander, these species are present in some of Newmarket's wetlands. Refer to Appendix C for a description of habitat requirements for these vernal pool species.

Threats to Vernal Pools
Some vernal pools are classified as wetlands under the jurisdiction of the New Hampshire Department of Environmental Services' Wetlands Bureau. However, because they are often very small in size and are dry for several months of the year, they may be incorrectly identified as "low value" wetlands, or due to the absence of hydrophytic vegetation and/or hydric soils, not recognized as wetlands at all. This often leads to direct loss of vernal pools through filling for development purposes.

Land use adjacent to pools affects their value as productive amphibian breeding sites. The loss of surrounding trees and other types of vegetation results in decreased shading, rising water

[11] NH Audubon, *ASNH Conservation Fact Sheet: Vernal Pools*, 1998, page 1.
[12] *ibid*., pages 1 –2.

temperatures, decreased oxygen content, increased evaporation, and alteration of the hydrologic regime. There may also be less debris to provide cover, nutrients, and attachment sites for egg masses. Many of the amphibians and reptiles that use vernal pools spend most of their year in the surrounding habitat, both uplands and wetlands. For example, spotted salamanders spend much of the year under leaves on the forest floor. Wood frogs and salamanders may come to breed in vernal pools from as far away as 1000 feet, and turtles from even farther.

Because some species are usually reluctant to cross large areas of altered terrain such as lawns or fields, changes to the terrain surrounding a vernal pool, such as clearing, creation of lawn, or building and paving, will have a detrimental impact on the species that use the nearby pool. Roads provide a lethal barrier to many species that must cross them to reach a vernal pool. Heavy traffic on the rainy nights when salamanders and frogs migrate can cause a great deal of mortality and impact local populations. Road salt and other chemicals from the road may also have an effect on the water quality in nearby vernal pools. In short, the upland area around the pool is just as important to these species' survival as the vernal pool itself.[13]

Identification and Documentation of Vernal Pools in New Hampshire is available from the Nongame and Endangered Wildlife Program of the New Hampshire Fish and Game Department by calling (603) 271-2461.

D. Local Protection Measures

Wetland Protection Overlay District
The requirements of Section 5.03 Wetland Protection Overlay District of the zoning ordinance apply to all areas of land that meet the criteria of the NHDES Wetlands Bureau rules for determination of wetlands, poorly drained soils, and very poorly drained soils, and prime wetlands as delineated by the Newmarket Conservation Commission and approved in accordance with RSA 482-A:15 and associated buffers as defined in the ordinance, as summarized in Table 12 below. Disturbance within prime wetlands, very poorly drained soils, and poorly drained soils is prohibited. Agricultural (including animal husbandry) and forestry uses are permitted providing such uses implement Best Management Practices. Forestry uses are permitted within prime wetlands and associated buffer providing tree removal complies with the CSPA requirements (as defined in RSA 483-b:9(V)(a)). Withdrawal of surface water is prohibited within this district.

Table 12. Requirements of Section 5.03 Wetland Protection Overlay District

Zoning Ordinance Provisions	Setback (feet)	*Buffer (feet)
Wetland Protection Overlay District [a]		
Very poorly drained soils	N/A	50
Poorly drained soils	N/A	25
Prime Wetlands	100, 125 [b]	75

* Limited Disturbance means some removal of vegetation or disturbance is permitted.

[a] Section 5.03 Wetland Protection Overlay District includes areas of land that meet the criteria of the NH Department of Environmental Services Wetland Bureau rules for determination of wetlands, poorly drained soils, very poorly drained soils, and prime wetlands.

[13] NH Audubon, *ASNH Conservation Fact Sheet: Vernal Pools*, 1998, page 3.

[b] Structures must be setback a minimum of 100 feet and septic systems must be set back a minimum of 125 feet from prime wetlands.

Limited construction and disturbances may be allowed in the district for the following uses and activities:

- access to and use of an adjacent surface water subject to all state requirements and approvals;
- construction within the wetland buffer of additions and extensions to single family dwellings that lawfully existed prior to the ordinance and in conformance with all applicable codes of the Town;
- driveway and utility crossings for the use of land areas outside the overlay district only if granted a Special Use Permit by the Planning Board upon determination of compliance with specified criteria (refer to Section (E) (1) - (4) in the ordinance for detailed description of criteria); and
- other dredge, fills or impacts (as defined in the ordinance) only if granted a Special Use Permit by the Planning Board upon determination of compliance with specified criteria including mitigation of impacts to wetlands (refer to Section (F) (1)-(5) in the ordinance for detailed description of criteria); the Planning Board may impose conditions of approval.

The following other restrictions apply to hydric soils.

Very Poorly Drained Soils (Hydric A) – Wetland areas containing very poorly drained soils may not be included in the minimum lot size for new lots as required by Section 3.02 of the Wetlands Overlay Protection District.

Poorly Drained Soils (Hydric B) - No more than 25% of a wetland area containing poorly drained soils can be included in the minimum lot size for new lots as required by Section 3.02 of the Wetlands Overlay Protection District.

Newmarket Open Space Plan

The following are recommendations for protection and restoration of wetlands from the Newmarket Open Space Plan (refer to page 87 of the Land Use Planning section):

Section 1: Implement the wetland mitigation projects in Newmarket as identified in a 2003 Report to the NH Estuaries Project, and other restoration projects as opportunities and funding allow.

- The Planning Board and Conservation Commission should review this list for potential mitigation sites during review of applications for subdivisions and wetlands impacts
- Consult the Great Bay Estuary Restoration Compendium (Odell et al. 2006) for opportunities to restore estuarine habitats and fisheries (*Lead: Planning Board and Conservation Commission*)

Section 2: Evaluate the tidal wetlands (saltmarsh) to assess for potential designation as prime wetlands, similar to the freshwater prime wetlands designation

- Apply for a grant to assist in evaluating the tidal wetlands (saltmarsh) in Newmarket for their potential designation as prime wetlands (*Lead: Conservation Commission*)

- Hire a certified wetlands scientist to conduct the saltmarsh evaluation and to complete the designation process
- If the Town is not able to re-establish Follett's Brook as a drinking water supply consider adding this wetland to the prime wetland designations.

E. State Protection Measures

NH Department of Environmental Services – Wetlands Bureau

The mission of the Wetlands Bureau is to protect, maintain and enhance the environmental quality in New Hampshire through the powers set forth in RSA 482-A to regulate impacts to those areas *wherever the tide ebbs and flows* or *freshwater flows or stands*. The functions of a wetland may be impaired and its benefits may be adversely affected when wetlands or surface waters are dredged, filled or structures are built in or adjacent.

Because wetlands perform numerous functions and offer benefits that are valued by the citizens of New Hampshire, RSA 482-A authorizes the Department of Environmental Services (DES) to protect the State's wetlands and surface waters by requiring a permit for dredge or fill or construction of structures in wetlands or other waters of the state. The law also protects sand dunes and upland tidal buffer zones. RSA-482-A and the rules promulgated under that law require that projects be designed to avoid and minimize impacts to wetlands and other jurisdictional areas.

The impacts that are proposed must be only those that are unavoidable, and it is the responsibility of the applicant to document these considerations in the application for a permit to disturb the State's wetlands and surface waters. Projects and activities in jurisdictional areas are categorized by the scope of impact, as summarized in the Table 13 on the next page.[14]

[14] NH Department of Environmental Services, NHDES Water Division: Wetlands Bureau, http://des.nh.gov/organization/divisions/water/wetlands/index.htm, July 23, 2009.

Table 13. Classifications and Application Types for Projects Requiring a Permit for Dredge or Fill or Construction of Structures in Wetlands or Other Waters of the State
[Source: NH DES Guidebook for Wetlands Permits (July 2, 2008)

Type of Application Form	**Project Classification** **Note:** Any project that proposes to impact an area in or adjacent to prime wetlands, in tidal wetlands, tidal buffer zone, sand dunes, bogs, or in a wetland that is an exemplary natural community or has endangered or threatened species, is classified as a **major project** regardless of the amount of impact requested		
	Minimum Impact	**Minor Impact**	**Major Impact**
Minimum Impact Expedited Permit	Repair or replacement of structures; seasonal dock in standard configuration with shoreline frontage less than 75 ft.;	Not Applicable	Not Applicable
Standard Dredge and Fill Permit	***All projects for which work has begun without a permit***		
	Fill for lot development, which impacts less than 3,000 sq. ft. of wetlands.	Impacts to wetlands is 3,000 - 20,000 sq. ft.; Construction of a pond with less than 20,000 sq. ft. of impact (has very poorly drained soils or an inflow or an outflow); Construction or replenishment of a beach with more than 10 cubic yards of sand but less than 20 cubic yards; Dredge 20 cubic yards or less from public waters.	Any project in or adjacent to prime wetlands, in tidal wetlands, tidal buffer zone, sand dunes, bogs, or in a wetland that is an exemplary natural community or has endangered or threatened species, regardless of amount of impact. More than 20,000 sq. ft. of impact to wetlands, surface waters or banks; Construction or modification of any major docking system. Dredge more than 20 cu. yds. in public waters; Disturb more than 200 linear feet of the shoreline of a lake, pond or its bank; Disturb 200 or more linear feet of a stream or river or its banks.

1-4 WATER QUALITY AND HABITAT PROTECTION

Policy Statement

Develop and implement policies, regulations and standards that ensure protection of water quality and wildlife habitat. These efforts should focus on land use, and conservation and management measures that ensure the sustainability of these resources.

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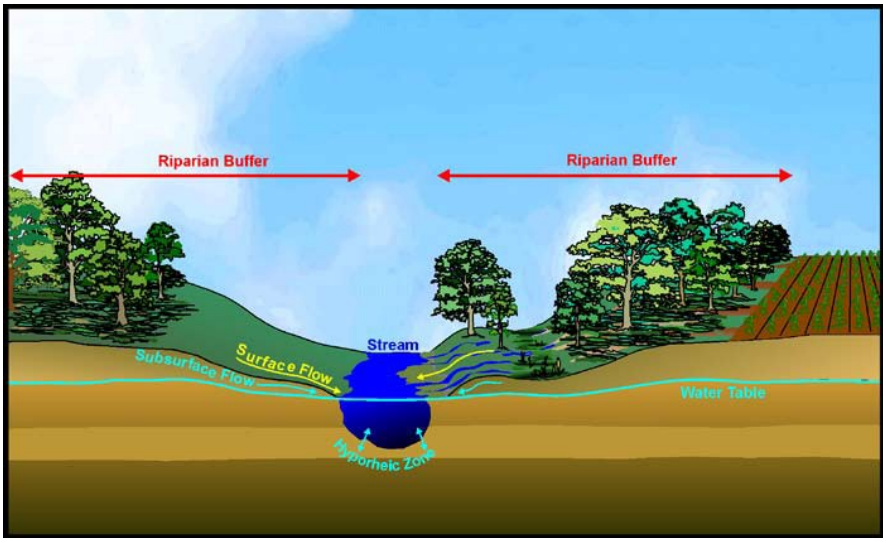
A. Buffer Functions and Services

The vegetated areas adjacent to surface waters - streams, rivers, lakes and ponds - are commonly called riparian areas. The term buffer refers to an area a specified distance from surface waters, and from wetlands, where disturbance to land and vegetation is restricted or prohibited. The primary function of a riparian buffer is to physically protect and separate resources from the effects of land and vegetation disturbance from human activity. The buffers absorb and filter runoff to protect water quality, intercept and slow runoff to prevent erosion, provide habitat for wetland species and upland species, and improve landscape and recreational aesthetics.

Figure 6. Illustration of Riparian Buffer Structure and Functions



Riparian Areas and Buffers for Water Quality Protection

In the 2005 report *The Effects of Urbanization on Stream Quality at Selected Sites in the Seacoast Region in New Hampshire, 2001-03*[15] there was found to be high correlations between the percent of urban land use in stream buffers and degradation of water quality. Generally, as the percent of urban land increased, stream quality decreased as measured by reductions in the combined score for water quality, habitat condition and biological condition. Table 14 illustrates the total buffer area in acres for varying widths of buffers along perennial and intermittent streams and along shoreline. For instance, a 300 foot buffer width would apply to almost 25% of the total town area while a 150-foot width buffer would apply to 12% of town area.

Table 14. Shoreline and Buffer Statistics for Perennial and Intermittent Streams in Newmarket [Source: GRANIT Data Mapper at http://mapper.granit.unh.edu/viewer.jsp]

Shoreline Buffer Width	Buffer Area (acres)	% Total Municipal Area*
Perennial and Intermittent Streams and Shoreline Length = 211,379.4 linear feet		
Perennial and Intermittent Streams and Shoreline Buffers		
50 foot width	374.4	4.1
100 foot width	739.7	8.2
150 foot width	1,097.2	12.1
200 foot width	1,449.9	16.0
250 foot width	1,797.9	19.8
300 foot width	2,143.6	23.7
Perennial Streams and Shoreline Length = 202,699.0 linear feet		
Perennial Streams and Shoreline Buffers		
50 foot width	354.8	3.9
100 foot width	701.3	7.7
150 foot width	1,041.4	11.5
200 foot width	1,377.5	15.2
250 foot width	1,709.2	18.8
300 foot width	2,038.3	22.5

* Total Town Area = 9,080.3 acres Total Surface Waters = 1,046.2 acres

Riparian Areas and Buffers for Habitat Protection

Benefits of Shorelands and Riparian Areas

Because of the close proximity to surface waters and wetlands, shorelands and riparian areas play an important role in maintaining the health of the surrounding environment and ecological systems. Maintaining riparian areas in a naturally vegetated condition within a specified minimum distance from surface waters and wetlands provides significant protection of water quality, wildlife and aquatic habitat.

[15] Jeffrey R. Deacon, Sally A. Soule, *Thor. E. Smith, Effects pf Urbanization on Stream Quality at Selected Sites in the Seacoast Region in New Hampshire, 2001-03,* NH Department of Environmental Services, http://pubs.usgs.gov/sir/2005/5103/, July 23, 2009.

Vegetated shoreland areas stabilize soil, reduce flood waters, moderate water temperature through shading, and filter sediments and nutrients from runoff. Riparian areas provide important functions and services for wildlife including food, shelter, travel corridors, and nesting areas. Riparian areas can be actively managed to attract wildlife and can be restored with native plantings and/or by allowing natural regeneration of vegetation. Refer to the publication *Protecting and Enhancing Shorelands for Wildlife* for a list of recommended plantings and their wildlife value. [16]

The Complex Systems Research Center at the University of New Hampshire conducted a *Stream Buffer Characterization Study* (2007)[17], which mapped and evaluated the condition of riparian buffers for the major rivers and streams in Newmarket. The results of this study are summarized in Table 15.

Table 15. Summary of Riparian Buffer Condition Data for Major Rivers and Streams in Newmarket

Buffer Characterization	*Decision Rule	150-foot buffer	300-foot buffer
Intact	<10% impacted	2.8%	3.2%
Mostly Intact	10-25% impacted	1.2%	2.9%
Somewhat Modified	25-50% impacted	1.1%	4.1%
Altered	>50% impacted	0.7%	1.3%
Percentage of Total Town Land Area		***5.8%***	***11.5%***

*Note: The *Decision Rule* establishes categories based on the degree to which each buffer or buffer segment was impacted by human activity, specifically the percent of land area within the buffer mapped by land use type as either developed, transportation, or agriculture.

Riparian buffers in Newmarket are relatively intact and unaltered in rural areas, and somewhat modified or impaired in locations where there is intensive development, based on the map produced by the *Stream Buffer Characterization Study*. In most areas of Newmarket, development is sparse along many of the small tributaries with some clearing for agricultural and residential uses adjacent to these surface waters.

Functional Widths of Buffers

Buffers that are naturally vegetated - whether with native grasses, forest or scrub-shrub species - are most effective in providing wildlife habitat, removing pollutants, protecting resources from contamination, and preventing negative impacts resulting from human activity. In the study *Introduction to Riparian Buffers*[18] guidelines for buffer widths by function are provided as summarized in Table 16.

[16] UNH Cooperative Extension, *Protecting and Enhancing Shorelands for Wildlife*, http://extension.unh.edu/resources/representation/Resource000428_Rep450.pdf, July 23, 2009.
[17] NHGRANIT, *Stream Buffer Characterization in Coastal NH*, UNH Complex Systems Research Center, http://www.granit.unh.edu/Projects/Details?project_id=42, July 23, 2009.
[18] Connecticut River Joint Commission, *Introduction to Riparian Buffers: For the Connecticut River Watershed*, http://www.crjc.org/buffers/Introduction.pdf, July 23, 2009.

Table 16. Guidelines for Functional Riparian Buffer Widths

Function	Buffer Width
Stabilize Banks	35-50 feet
Filter Sediment	35-150 feet (if slopes are less than 15 percent)
Filter Dissolved Nutrients and Pesticides	100-500 feet; 100 feet removes about 60 percent of pollutants
Protect Fisheries	At least 100 feet
Protect Wildlife	Minimum 300 feet (600+ feet for nesting birds)
Flood Control	Varies with size and position in watershed

It is widely recommended in current scientific literature that riparian buffers be increased when land is steeply sloped, is used intensively, contains erodible soils, is located in a floodplain, and where a stream or river naturally meanders.

Application of Guidelines for Buffer Widths
The Planning Board and Conservation Commission may refer to the buffer guidelines above when evaluating development in sensitive areas. These buffer width guidelines may be used to identify expanded buffers necessary to achieve specific protection of natural resources and environmental functions and benefits.

B. Water Quality Monitoring

The NH Department of Environmental Services (NHDES) through its Volunteer River Assessment Program (VRAP) maintains a water quality-monitoring program for the Lamprey River and its tributaries. In 1999, volunteers from the Lamprey River Watershed Association began water quality monitoring in the Lamprey River watershed. The goal of this effort was to provide water quality data from the Lamprey River watershed relative to surface water quality standards and to allow for the assessment of the river for support of aquatic life and primary contact recreation (swimming). Long-term monitoring provides a basis for understanding the river's dynamics, or variations on a station-by-station and year-to-year basis. The data also serves as a baseline from which to determine any water pollution problems in the river and/or watershed. Water quality monitoring reports from 1998 to 2006 are available at the NHDES website at http://www.des.state.nh.us/WMB/VRAP/lamprey.html.

During 2007, trained volunteers from the Lamprey River Watershed Association monitored water quality at 20 stations in the Lamprey River watershed. Water quality testing is performed for the Piscassic River (a tributary of the Lamprey River) at 3 sampling sites in Newmarket:

- Sampling Site 02-PIS (Class A waters) at Route 152 Bridge
- Sampling Site 01-PIS (Class A waters) at Route 108 Bridge
- Sampling Site –5-LMP (Class B waters) at Packers Falls Road.

Water quality monitoring was conducted from June to September. In-situ measurements of water temperature, air temperature, dissolved oxygen, pH, turbidity and specific conductance were taken using handheld meters, and samples for E. *coli bacteria* and chloride were taken for laboratory analysis.

In 2007, water quality at all three sites did not meet the New Hampshire surface water quality standards for pH (between 6.5 and 8.0 (unless naturally occurring)) and Sampling Site 01-PIS did not meet standards for dissolved oxygen (6 mg/L at any place or time, or 75% minimum daily average – (unless naturally occurring)). Sampling Sites 01-PIS and 05-LMP did not meet NHDES quality assurance/quality control standards for dissolved oxygen (5 mg/L at any place or time or 75% minimum daily average – (unless naturally occurring)).

pH is influenced by geology and soils, organic acids (decaying leaves and other matter), and human-induced acids from acid rain (which typically has a pH of 3.5 to 5.5). Elevated pH levels can be naturally occurring and are not uncommon in New Hampshire's surface waters due to contributions from atmospheric deposition (acid rain).

C. Local Protection Measures

Surface water resources are protected through various measures and requirements contained in Newmarket's zoning ordinances.

- A principal measure includes the two-acre minimum lot size requirement for residential (R-1) zoned areas, which account for roughly 70% of the land area in Newmarket. This measure minimizes the amount of impervious area coverage and dissipates any potential adverse effects related to on-site septic systems by imposing adequate separation distances between systems.
- The Class A Watershed Protection Overlay District (Section 5.04) requires that any new septic system must be set back a minimum of 150 feet from Class A surface waters. Class A surface waters in Newmarket include the Piscassic River and Follett's Brook.
- The Shoreline Protection Overlay District (Section 5.02), which includes all land areas within 250 feet of the tidal waters of Great Bay, the tidal and non-tidal portions of the Lamprey River, and the Piscassic River. The ordinance contains specific restrictions, such as the amount of vegetation that can be removed, the minimum amount of shoreland frontage, structure setbacks and the amount of shoreland frontage that can be used for water access.
- The Aquifer Protection Overlay District (Section 5.00), Wetland Protection Overlay District (Section 5.03) and Steep Slope Protection Overlay District (Section 5.05) also contain certain land development restrictions to protect water quality.

D. State Protection Programs

At the state level, the NH Department of Environmental Services (NHDES) administers several programs and regulations that are designed to protect surface water quality. These NHDES Programs include the Nonpoint Source Pollution Assessment Program, the Site Terrain Alteration Permit Program, the Protection of the Purity of Surface Water Supplies rule (Env-Ws 386) and the Surface Water Classification System to name a few. The following summarizes the principal requirements for each Program.

Site Specific Permit Program (Alteration of Terrain)
The NHDES has jurisdictional review and a permitting process for all land development activities that will disturb an area of more than 100,000 square feet, or 50,000 square feet in locations within 250 feet of a designated public water body, to insure that adequate erosion control and storm water management measures will be implemented to treat runoff before it leaves the proposed site. *Refer to Section 1-8 (D) for a detailed description of program requirements and new requirements proposed in 2008 as amendments to RSA 485-A:17 Terrain Alteration.*

Protection of the Purity of Surface Water Supplies (Env-Ws 386)
Commonly referred to as the State Watershed Rule, this Program enables a water supplier or municipality to develop specific protection requirements to protect a surface water supply source over large watershed areas and especially where such watersheds extend into other municipalities. Upon review and approval by NHDES, the protective provisions are then adopted as part of NHDES's administrative rules, with the water supplier remaining as the principal enforcer. Currently, there are 30 out of 59 active surface water sources statewide that have adopted some level of protection under this Rule. The requirements generally include the use of buffer zones with widths typically ranging between 75 to 200 feet, various land use restrictions and some prohibit boating or swimming. This Rule enables municipalities to broaden the use of storm water treatment devices, buffer zones, infiltration measures for ground water recharge, or other land use restrictions to protect the quality of the water supply where such measures would not otherwise be required by other state or local environmental regulation.

As part of a recently developed *Innovative Land Use Planning Techniques Guide*, the NHDES in coordination with the Regional Planning Commissions has developed a regulatory model for protection of surface water supplies entitled *Model Drinking Water Ordinance for Protection of Surface Water Supply Areas and Sources.* The ordinance is available on the NHDES website at http://www.des.state.nh.us/repp/index.asp?go=ilupth.

Surface Water Quality Regulations (Env-wq 1700)
All surface waters of the state are either classified as Class A or Class B, with the majority of waters being Class B. NHDES maintains a list that includes a narrative description of all the legislative classified waters. Designated uses represent the uses that a waterbody should support (as described in RSA 485-A:8). Water quality standards for Class A and Class B waters include maximum limits for various parameters, including E. coli bacteria, nutrients, turbidity, temperature, pH, dissolved oxygen, and various metals and other toxic substances. Certain activities that have the potential to degrade the water quality and to cause instream concentrations to exceed these standards are prohibited. Surface waters are classified as Class A and Class B based on their designated use. Class A waters are considered to be of the highest quality and are generally acceptable for use as public drinking water sources after filtration and disinfection, and discharge of sewage or wastes into waters of this classification is prohibited. Class B waters are considered to be the second highest quality and generally have water quality that supports designated uses for aquatic life, drinking water after adequate treatment, fish consumption, and primary and secondary contact recreation. In Newmarket, the Piscassic River

and Follett's Brook are the only water bodies designated as Class A waters. All of the other water bodies in Newmarket are considered to be Class B waters.

Rivers Management and Protection Act (RMPP)

The Rivers Management and Protection Act was established in 1988 with the passage of RSA 483 to protect certain rivers, called designated rivers, for their outstanding natural and cultural resources. The RMPP is administered by the NHDES. Under this program specific river segments are designated, following nomination by local interests, to receive additional protection against discharges, land use activities along the shoreline, flow alterations and water withdrawals (currently pending new regulations). Currently, there are 16 rivers (in some cases not entire rivers but specific river segments) designated under this program. The Lamprey River designation required the establishment of the Lamprey River Advisory Committee.

Comprehensive Shoreland Protection Act (CSPA)

In June of 2007, the New Hampshire legislature enacted amendments to the Comprehensive Shoreland Protection Act (CSPA). The CSPA provides protection to the state's public waters by establishing a forested buffer area as well as restricted use areas within 250' of NH's lakes, large ponds, and fourth order and larger rivers.

The CSPA changes are broad in scope and are designed to strike a balance between the rights of shoreland property owners and the need to protect our shoreland resources. An additional 1,391 miles of river will come under the protection of the CSPA as a result of the adoption of the New Hampshire Hydrography Dataset (NHD) for stream order determination. In addition, all rivers designated under the state's Rivers Management Act will now come under the protection of the CSPA. The current procedures to obtain waivers to expand the footprint of non-conforming structures or variances from the standards in RSA 483-B:9,V, such as septic setbacks, will still be available under the revised CSPA. Refer to Section 1-2 (E) Surface Waters of this Chapter for public waters that are jurisdictional under the CSPA in Newmarket.

Figure 7. NH Coastal Watershed Communities

New Hampshire Coastal Program (NHCP)

In 1972, the U.S. Congress passed the Coastal Zone Management Act (CZMA) in recognition of the importance of the nation's coastal resources. The NH Coastal Program (NHCP) gained federal approval in 1982 and is administered by the NH Department of Environmental Services.

The NH Coastal Program focuses primarily on the seventeen communities in the coastal tidal influence zone, but does work with the entire coastal watershed consisting of 42 communities. Newmarket is a Zone A (tidal influence) community.

The New Hampshire Coastal Program's mission is to balance the preservation of natural resources of the coast with the social and economic needs of this and succeeding generations. To accomplish this mission, the Coastal Program focuses on five primary goals to: prevent and abate coastal pollution; provide for public access to coastal lands and waters; foster community stewardship and awareness of coastal resources; protect and restore coastal natural resources; and encourage a viable economy with adequate infrastructure.

NHCP's Strategic Plan defines the Program's coastal management objectives for the next two to three years, focusing on areas with the most demonstrated need that protect coastal resources. Priority Areas of the Strategic Plan include:

Goal 2: Improve science-to-management in local communities.

A. Increase community planning to protect water resources:
   - Partner with other NHDES programs and organizations to help communities designate ***Prime Wetlands***. If possible, set aside small amount of funding for one community to use on an annual basis.
   - Work intensively with a community that is ***updating the water resources section of its master plan***, to make sure that all the water-related information is included in the planning and decision-making process, such as groundwater, buffers, and restoration.
   - Continue to connect local decision makers with ***information needed to protect water resources, like new planning tools and resources***.

B. Support organizations and entities that assist communities with planning and data collection, compilation and interpretation.
   - Provide funding to organizations and entities that ***assist communities with planning, data collection, compilation and interpretation***.

Goal 3: Protect and restore natural habitats in the coastal watershed.

A. Participate in developing, revising, and implementing state policies that protect coastal resources.
   - Participate in the development of ***reworking wetlands, river, or habitat wetland-related rules.***

The goals of the NHCP's Strategic Plan clearly support many of the recommendations contained in this Water Resources Chapter, making this agency an informed and potentially viable partner in providing technical assistance and funding for implementation. NHCP funding sources include: Competitive Grant Program, Coastal and Estuarine Land Conservation Program, and program funding through the Regional Planning Commission (the source of funding for development of this Chapter).

NH Department of Environmental Services (NHDES)

The various programs of the NHDES provide technical assistance and funding opportunities for nearly every sector of natural resource protection and management from drinking water supply protection to non-point source pollution abatement to land conservation. However, it is necessary to become familiar with each program and the resources that are available to determine appropriate partnerships and achieve results in implementing the recommendations of the Water

Resources Chapter. It may be helpful to organize a working group or subcommittee of elected officials and board and commission members to take on this task and to develop the necessary contacts and partnerships to move forward.

E. Federal Protection Programs

Piscataqua Region Estuaries Partnership

The Piscataqua Region Estuaries Partnership (PREP) is part of the U.S. Environmental Protection Agency's (EPA's) National Estuary Program, which is a collaborative local/ state/federal program established under the Clean Water Act with the goal of promoting the protection and enhancement of nationally significant estuarine resources. The PREP receives its funding from the EPA and is administered by the University of New Hampshire. The mission of the PREP is to protect, enhance, and monitor the environmental quality of the state's estuaries.

Approved in 2001 and updated in 2005, the PREP Comprehensive Conservation and Management Plan is an approach to protect and enhance the state's estuaries. Covering forty-two watershed communities, the collaborative process to develop the watershed plan involved the work of researchers, planners, resource managers, concerned citizens and other coastal stakeholders. The plan describes actions to be undertaken throughout New Hampshire's coastal watershed to achieve and sustain healthy estuarine systems. The Management Plan identifies priority actions in five areas: 1) Water Quality, 2) Land Use, Development, and Habitat Protection, 3) Shellfish Resources, 4) Habitat Restoration, and 5) Public Outreach and Education. The PREP study area covers the entire coastal watershed of New Hampshire, including all the freshwater tributaries that flow into the estuaries in the state.

The PREP Management Plan identifies and recommends various water quality and habitat protection goals and action plans that are considered necessary to protect the aquatic and shoreline resources of the Great Bay Estuary and other coastal waters. The PREP Management Plan draws from various studies and monitoring activities and identifies numerous action plans to improve or protect resources. The Plan is being updated in 2009.

The Natural Resources Conservation Service Programs[19]

The Natural Resources Conservation Service (NRCS) is the lead conservation agency within the U.S. Department of Agriculture with technical staff in the area of soils, agronomy, engineering, biology, forestry and economics to help landowners and land users with conservation. They provide solutions, collect and assess natural resources data, and provide information and education. NRCS partners include conservation districts, government agencies, agricultural and environmental groups.

In New Hampshire NRCS has a strong emphasis on conservation planning. The Farm and Ranch Lands Protection Program establishes partnerships with land trusts, governments, and non-profit

[19] Natural Resources Conservation Services, US Department of Agriculture, http://www.nh.nrcs.usda.gov/, July 24, 2009.

agencies to purchase conservation easements on farmland in New Hampshire. These easements protect agricultural land, and important farmland soils, by prohibiting conversion to non-agricultural uses. Since the Farm and Ranch Lands Protection Program came into existence in 1996, NRCS in New Hampshire has provided over $15 million dollars to support the purchase of, and provide permanent protection for 6,366 acres of agricultural land on 85 farms across the state.

The Wetlands Reserve Program (WRP) is a voluntary program to restore and protect wetlands on private and public property. It is an opportunity for landowners to receive financial incentives to enhance, protect, or restore wetlands to the original hydrology, functions and values, native vegetation, and natural topography. Landowners who choose to participate in WRP may sell a conservation easement or enter into a cost-share restoration agreement with USDA to restore and protect wetlands. The landowner voluntarily limits future use of the land, yet retains private ownership. The landowner and NRCS develop a plan for the restoration and maintenance of the wetland. Other agencies may provide additional assistance for easement payment and wetland restoration costs as a way to reduce the landowner's share of the costs. Such special partnership efforts are encouraged. To be eligible for WRP, land must be restorable and be suitable for wildlife benefits.

The Wildlife Habitat Incentive Program (WHIP) is a voluntary program that provides technical and financial assistance to people who want to improve fish and wildlife habitat or restore natural ecosystems on their land. NRCS will provide compensation for part of the cost of establishing and maintaining conservation practices that are necessary for enhancing and improving wildlife habitat and restoring natural ecosystems.

Great Bay National Estuarine Research Reserve Program

The mission of the National Estuarine Research Reserve Program is the establishment and management, through federal-state cooperation, of a national system of estuarine research reserves representative of the various regions and estuarine types in the U.S. Great Bay is one of a network of state owned and managed protected areas established to provide opportunities for long-term research on coastal management, stewardship, public awareness and scientific understanding of estuarine areas. The Reserves are designated and supported by the National Oceanic and Atmospheric Administration (NOAA) under the U.S. Department of Commerce.

The New Hampshire Fish and Game Department Marine Fisheries Division manages the Great Bay National Estuarine Research Reserve. Designated in 1989, the Reserve's primary purpose is to promote the wise use and management of the Great Bay Estuary. Encompassing over 25,000 acres of tidal waters and uplands, the Reserve is part of the Atlantic flyway and located in the Arcadian bioregion. For more information please visit http://www.greatbay.org/.

F. Regional and Watershed Conservation

Great Bay Resource Protection Partnership
The Great Bay Resource Protection Partnership is a group of organizations committed to protecting the important habitats of the Great Bay region. The Great Bay Partnership has

undertaken a comprehensive, landscape-scale approach to conservation and habitat protection within 24 towns around Great Bay. Since 1994, the Great Bay Partnership has operated as a cooperative effort intended to further collective conservation goals and promote conservation actions in the Great Bay region. Habitat protection strategies and stewardship activities are developed and implemented through the integration of scientific field studies and collaboration with local, regional, state and national conservation partners. The primary activities of the Great Bay Partnership include:[20]

Conservation Planning. The Partnership conducts habitat analysis studies to identify significant habitat areas to be considered for protection.

Land Conservation. Based on the conservation planning field work, the Partnership seeks to protect large blocks of significant conservation land through working voluntarily with landowners on the purchase or donation of land or conservation easements.

Stewardship. Partner organizations collaborate on stewardship activities such as restoration, resource management and public access on protected lands.

***Education and Outreach*.** Partner representatives provide technical assistance to communities, conservation entities and landowners.

The Great Bay Partnership includes state and regional private non-profit conservation organizations and land trusts, federal and state public agencies, and municipalities. The goals of the Partnership are to:

- Promote creative solutions for habitat protection.
- Build upon the conservation efforts of already protected and restored lands.
- Coordinate resources, and identify and pursue a variety of funding opportunities.
- Promote communication and cooperation between partnering entities.

Principal Partners

- Ducks Unlimited, Inc.
- Great Bay National Estuarine Research Reserve
- New Hampshire Audubon Society
- New Hampshire Fish and Game Department
- Society for the Protection of New Hampshire Forests
- The Nature Conservancy, New Hampshire Chapter
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service, Great Bay National Wildlife Refuge
- U.S.D.A. Natural Resources Conservation Service

Associate Partners

[20] Great Bay Resource Protection Partnership, *Partners in Protecting New Hampshire's Great Bay Habitats*, http://www.greatbaypartnership.org/, July 23, 2009.

- Southeast Land Trust of New Hampshire
- Bear Paw Regional Greenways
- Rockingham County Conservation District
- Strafford Rivers Conservancy
- Strafford County Conservation District

1-5 FLOOD PLAINS AND FLOOD MANAGEMENT

Policy Statement

Implement regulatory, educational and voluntary measures to maintain the functions of flood plains and to minimize impacts of flooding on natural resources and damage to municipal and private property.

A. FloodPlains and Flood Zones

Newmarket has 1,159.5 acres of floodplain comprising 12.8 percent of the town's total land area. The 100-year flood plain is generally consistent in extent with wetland areas and adjacent to the Lamprey River and Swampscott Rivers, Piscassic River and Follett's Brook, and Lubberland Creek. Most of the major drainage systems in Newmarket have fairly expansive floodplain areas.

Development in the Floodplain
Based on the 2006 Hazard Mitigation Study, approximately 155 residential structures were identified in the floodplain, with an estimated value of $32,811,900. The study identified an additional five commercial structures in the floodplain with an estimated value of $911,300. (Note – Structures were identified using 2003 aerial imagery and because of vegetation cover, some structures may not have been identified.)[21]

[21] Strafford Regional Planning Commission, *Town of Newmarket, New Hampshire: Hazard Mitigation Plan*, 2006, chapter 5 - page 2.

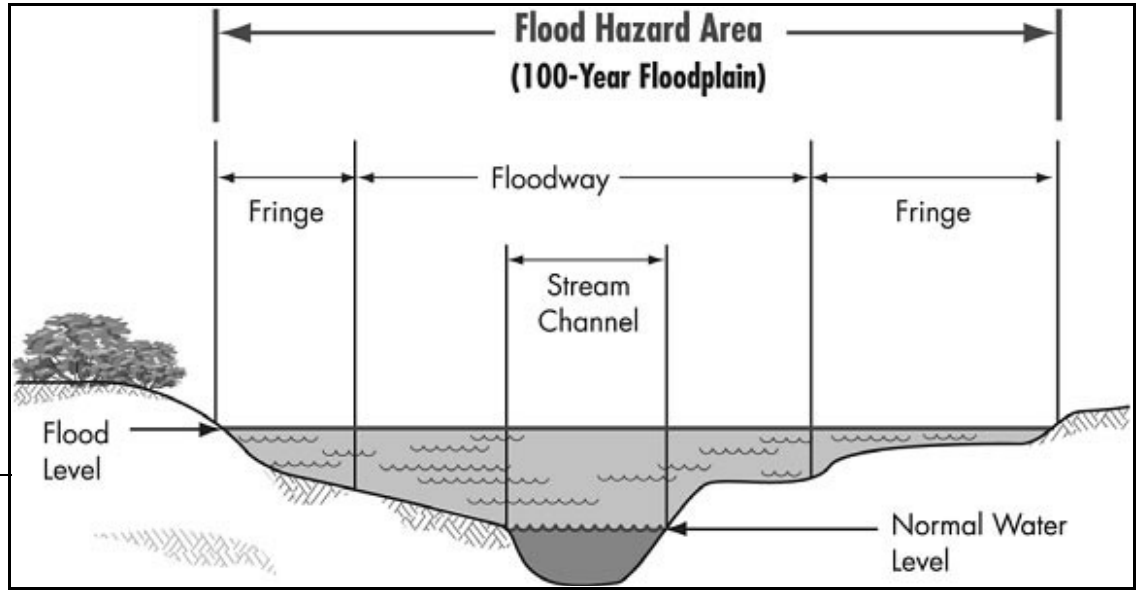
About Floodplains

Flood plains are generally low-lying areas adjacent to rivers, streams and other surface water bodies, which are susceptible to flooding. Floodplains perform an important water storage function, during storm events and periods of excessive water run-off, by storing water temporarily and gradually releasing it back into the drain system or infiltrating floodwater into the subsurface where it is discharged to streams and recharge groundwater.

Although the flood mitigation capacity of floodplains are relatively well protected by federal and local regulations, other factors can contribute to increased flooding. These factors include: increases in impervious surface coverage, filling of wetlands in the upper watersheds, stormwater management practices that increase peak flow rates, inadequate infrastructure to accommodate current storm flow volumes, beaver dams and less natural dissipation of flood flows through infiltration and interception by trees and vegetation.

Refer to Figure 8 on the next page for the components of a floodplain: channel, floodway, fringe and flood hazard area or 100-year floodplain. The floodway and flood fringe serve as critical floodwater storage areas, and the floodplain vegetation acts to slow the velocity of floodwaters and reduce erosion of the floodplain and adjacent lands.

Figure 8. Anatomy of the 100-year Flood Plain and Flood Hazard Area
[Source: Floodplain Learning on Demand: A New Hampshire Based Resource, Floodplain 101 – Understanding the Language at http://www.nhflooded.org/flood_plains101.php]



Federal Emergency Management Agency (FEMA)

The Federal Emergency Management Agency (FEMA) produces FIRMs (Flood Insurance Rate Maps) to delineate the 100-year flood plain boundaries, special flood hazard areas and other flood risk zones as determined by FEMA. A series of 9 FIRM maps identify these areas for the entire town.[22] Municipalities and state agencies use FIRMs in land use planning, land regulation and flood hazard mitigation planning efforts. Federal agencies and lending institutions use FIRMs to locate properties and buildings in relation to mapped flood hazards, and to determine whether flood insurance is required when making loans or providing grants following a disaster for the purchase or construction of a building.

A recent ongoing independent evaluation of recent flooding in New Hampshire found that FEMA FIRMs used by most communities in the state are sometimes decades out of date. Studies of peak discharges and flood levels by the U.S. Geological Survey indicate the height of floodwaters resulting from the 2006 and 2007 flood events were often different than predicted by FEMA maps because the hydrology and morphology of many rivers have changed since the maps were developed.[23]

B. Flood Events and Flood-Prone Areas

Newmarket has no existing man-made flood control measures. During extreme flood events, floodwaters from the Lamprey River overflow NH Route 108 upstream in Durham and are diverted into the Oyster River basin. This diversion of floodwaters reduces peak flood discharges of the Lamprey River by approximately 20 percent before it reaches the town.[24] Therefore, the Oyster River drainage basin serves an important flood protection and mitigation function for the town. Refer to Appendix E for a map of potential flood hazard areas from the Newmarket Hazard Mitigation Plan and to Appendix G - Water Resources Map.

[22] Note: The FIRM maps are located in the Newmarket Town Hall and can be viewed on the FEMA website at www.fema.gov, "Flood Insurance, Maps and Information" link.
[23] "NH Flood Maps Outdates, FEMA-Sponsored Study Finds," *Insurance Journal*, July 3, 2008 (http://www.insurancejournal.com/news/east/2008/07/03/91582.htm), July 23, 2009.
[24] Federal Emergency Management Agency, *Flood Insurance Study, Town of Newmarket, New Hampshire, Rockingham County*, 1991.

Numerous floods have been recorded on the Lamprey River since the U.S. Geological Survey (USGS) installed a gauging station near Packers Falls in Durham in July 1934. Historically, the two largest flood events since 1934 occurred in March 1936 (peak discharge of 5,490 cubic feet per second) and April 1987 (peak discharge of 7,500 cubic feet per second). These events had estimated frequencies of 25 and 100 years respectively. In recent years, these historical flood events were exceeded in Spring 2006 and 2007.

Areas Subject to Flooding

In the past, Newmarket has experienced flooding in the following areas: Packers Falls Road, River Street, Piscassic Street, Bay Road, Lamprey Street, Creighton Street, Route 108 at Durham border, Route 108 at Hersey Lane, Route 152 at Grant Road, New Road , Moonlight Bridge, Ash Swamp Road and Wadleigh Falls Road intersection, Route 152 at Lang's Lane, and at the Twin Rivers and Rivermoor housing complexes.[25]

May 2006 Mother's Day Flood Event

From May 11-15 2006, central and southern New Hampshire experienced severe flooding caused by as much as 14 inches of rainfall. In addition to the precipitation volume being exceptional, the month of May 2006 was the second wettest May in New Hampshire on record (based on NOAA data). The U.S. Geologic Survey Lamprey River gauging station located near Packers Falls Road Bridge measured the highest flow ever recorded of approximately 8,970 cubic feet per second (CFS) on May 16. This flood level was estimated to be a flood event with a recurrence interval between 100 and 500 years. The Piscassic River rose to a level that exceeded its normal drainage basin, entered Moonlight Brook, and was impounded behind the PanAm culvert at intersection of Gerry Avenue and Exeter Street. The earthen embankment at the railroad arch culvert subsequently failed and storm flows flooded Route 108, in the "Exeter Street Bowl." During this flood event, floodwaters in Exeter Street were approximately four feet deep, vehicles were submerged, oil tanks and dumpsters displaced and silt from eroded roadways and foundations was discharged into the Lamprey River[26]. As a result of the flood damage, a presidential disaster declaration was made on May 25, 2006 for seven New Hampshire counties, including Rockingham County.

Patriot's Day 2007 Flood Event

On April 15 and 16, 2007 nearly seven inches of rain fell in Newmarket.[27] The U.S. Geologic Survey Lamprey River gauging station located near the Packers Falls Road Bridge measured a peak flow of approximately 8.450 cubic feet per second on April 18, 2007, the second highest flow. This flood level was estimated to have a recurrence interval of just below 100 years. Normal flows for this date would be 654 cubic feet per second. While there was flooding in the "Exeter Street Bowl" again, the damage was not as severe as occurred with the 2006 flood. Flooding in the New Road area extending to Exeter Street was significant necessitating temporary road closures.

[25] Strafford Regional Planning Commission, *Town of Newmarket, New Hampshire: Hazard Mitigation Plan*, 2006, chapter 3 – page 3.
[26] Underwood Engineering, *Exeter Street Drainage Study*, 2009.
[27] *ibid*.

Local Flood Impacts in 2006 and 2007
The floods resulted in significant damage to public and personal property in Newmarket. Roads were impassable for days and severely damaged, and residential areas were evacuated due to high water levels and inundation of homes by floodwaters.

Watershed Based Flood Management
Existing local subdivision and site design regulations do require onsite storm water controls to reduce peak flows from new development, however, a more regional or watershed-wide hydrologic analysis may be necessary to evaluate the cumulative effect of multiple development projects in the watershed. Even though runoff from each individual development might be adequately controlled, as the larger watershed becomes more and more developed there is a cumulative effect that influences the timing and magnitude of peak flow conditions downstream. In addition, frequently roadway culverts or storm drains are sized based on current conditions and years later as more development has occurred within the watershed, these culverts may end up being undersized to handle the increased peak flows.

Independent Evaluation of Recent Flooding in New Hampshire
Following the devastating flood of April 2007, Governor Lynch requested an evaluation of the causes of recent flooding in southern New Hampshire. The NH Department of Environmental Services (NHDES) launched an independent evaluation to determine the specific causes of recent floods and provide recommendations for improving water management procedures and dam operations to reduce the impacts from future flood events. The evaluation is being funded by the Federal Emergency Management Agency (FEMA) and performed by a team led by an international engineering firm. In addition, an independent panel of national experts in water resources management will oversee the entire study to ensure that the work and recommendations meet the highest level of professional independence and expertise.[28]

Preliminary findings of the independent evaluation include:

- May 2006 event was caused by extremely heavy rainfall.
- April 2007 event was caused by a combination of rain and snowmelt.
- Dam operations generally did not aggravate flooding.
- Actions to mitigate future flooding include improving floodplain management and long-range flood forecasting, and using a watershed-based approach to flood operations and planning.

[28] NH Department of Environmental Services, *Independent Evaluation of Recent Flooding in New Hampshire*, Press Release, December 3, 2007 (http://des.nh.gov/media/pr/documents/071203.pdf), July 23, 2009.

The study recommends actions to mitigate flooding through more accurate floodplain mapping and by protecting the floodplain from development. Other recommendations include: application of the Vermont Fluvial Erosion Hazard Mapping Methodology to New Hampshire rivers and streams; removal of sediment and debris from channels to the extent allowed by law; safe flashboard operations; and determining costs and benefits of renovations at dam sites in the upper watersheds.[29] [Find more information at Vermont Department of Environmental Conservation website at http://www.anr.state.vt.us/cleanandclear/rivstrm.htm].

On July 13, 2009 the Governor Lynch signed HB290 authorizing municipalities to adopt fluvial erosion hazard ordinances. These ordinances would be based on delineation of zones consistent with any protocols established by the Department of Environmental Services and reviewed for consistency by the state.

C. National Flood Insurance Program

The National Flood Insurance Program (NFIP), administered by the Federal Emergency Management Agency (FEMA), is designed to manage floodplains and restrict development in floodplains in order to reduce flood hazards and structural damage. Under this program, flood hazard areas are mapped and studied in participating communities. The community is then responsible for adopting and enforcing flood management regulations within designated areas. The National Flood Insurance Program (NFIP) is a partnership between a community and the federal government. In communities that participate in the NFIP, property owners and renters can purchase insurance to protect them against losses from flooding. Communities participate by agreeing to adopt and enforce a floodplain management ordinance designed to reduce future flood risks. Newmarket has been a participating community in this program since 1991. It has continually updated its ordinances to maintain this status, with the last update occurring in May 2005 when the FEMA FIRMs were incorporated by reference into the town's Floodplain Protection Overlay District ordinance.

D. Local Protection Measures

Floodplain Protection Overlay District
Newmarket adopted Section 5.06 Floodplain Protection Overlay District as part of the zoning ordinance in May 1998. The Overlay District includes all areas within the 100-year floodplain zone as delineated on the FEMA maps as Zone "A" or is determined by a specified flood elevation. Generally, the ordinance requires that any new development within a floodplain zone must obtain a permit from the Code Enforcement Officer and the lowest floor elevation (including basement) must be built at or above the 100-year flood elevation. All new construction or substantial improvements shall be designed or modified and adequately anchored to prevent

[29] NH Office of Energy and Planning, *Floodlines*: *New Hampshire's Floodplain Management Newsletter*, Summer 2008

floatation, collapse or lateral movement from the effects of floodwaters. New structures or expansion of existing structures may be constructed within this overlay district only in the M-1 and M-2 districts.

Stormwater Regulations and Requirements

Stormwater requirements are found in the Town's site plan, subdivision and zoning regulations as described below.

Site Plan Regulations

Section 3.07 Drainage. All developments shall make adequate provisions for storm water treatment.

(A) Connection to the municipal storm drainage system shall be required if available within 100 feet of any boundary of the property, or as otherwise determined necessary by the Board.

(3) Storm water runoff shall be carried away in a subsurface piped storm sewer system.

(B) Lacking connection to the municipal storm drainage system, the site shall be designed with provisions for retention and gradual release of storm water. This shall include provisions for upgrading the existing drainage system if it is inadequate. All additional storm water and runoff which results from the proposed development shall be retained on-site and shall not drain onto adjacent properties, roads or waterways in an amount which exceeds predevelopment levels unless appropriate drainage easements are obtained. Oil/grease separators may be required for parking lots of sites in close proximity to the Lamprey River, Piscassic River or Great Bay, or in other areas where water contamination is of concern.

(C) Drainage plans shall include a maintenance program to be followed by the site owner, with specific required actions called out by year. Notice shall be provided to the Code Enforcement Officer annually as to compliance with the maintenance program.

(D) Drainage facilities shall be designed to accommodate a 25-year storm event. A culvert or other such component shall be large enough to accommodate potential runoff from its entire upstream drainage area. On-site retention or detention facilities may be required to prevent overloading of existing downstream facilities, or improvement to the downstream facilities may be required.

Subdivision Regulations

The stormwater requirements are identical to the requirements listed above for Site Plan Regulations with the exception of additional requirements in parts (B)(1) and (2) below.

Section 3.03 Design Standards.

(B) Lacking connection to the municipal storm drainage system, the subdivision shall be designed with provisions for retention and gradual release of storm water. All additional storm water and runoff which results from the proposed development shall be retained on-site and shall not drain onto adjacent roads, nor onto adjacent properties or into waterways in an amount which exceeds predevelopment levels unless appropriate drainage easements are obtained.

(1) Where the road frontage of the lots in the subdivision, or a portion thereof, averages 150' or more per lot, an open ditch and swale drainage system may be used.

(2) Where the road frontage of the lots in the subdivision, or a portion thereof, averages less than 150' per lot, an enclosed drainage system shall be required, and granite curbing shall be installed throughout to channel storm water into the drainage system.

Zoning Ordinance

- Section 5.01 Aquifer Protection Overlay District. Maximum Lot Coverage. Within the Aquifer Protection District, for any use that will render impervious more than 10% or more than 2,500 square feet of any lot, whichever is greater, a stormwater management plan shall be prepared.
- Section 1.05 Nonconforming Uses. Nonconforming uses shall not be expanded within the 100-year floodplain. Structures on nonconforming lots shall not be located within the 100-year floodplain.

To evaluate the cumulative effects of development in the local watersheds, the current local subdivision and site design regulations may need to be amended to clarify that post-development peak flow rates should not exceed predevelopment flow rates for the smaller runoff events (i.e., 2 year design storm) as well as the larger 25- and 50-year storm events. The regulations also require onsite management of peak flows generated from storms smaller than the 25-year storm event.

1-6 GROUNDWATER RESOURCES

Policy Statement

Protect the volume and quality of groundwater resources for use as future sources of drinking water and to protect the hydrology of surface waters and wetlands.

A. Stratified Drift Aquifers

Stratified drift aquifers consist of well-sorted, sand and gravel deposits that are typically laid out in layers by historic glacial outwash streams and rivers. Depending on the depth and the coarseness of the material, these deposits generally provide good sources of groundwater because of their high capacity to store groundwater over large areas. Table 17 below shows the acreage of stratified drift aquifers in Newmarket.

Table 17. Acres of Stratified Drift and Till Aquifers
[Source: NH GRANIT]

Type	Acres	% Total Municipal Area

Stratified Drift	657.5	7.2
Till	3,062.6	33.7
Total	**3,720.1**	**40.9**

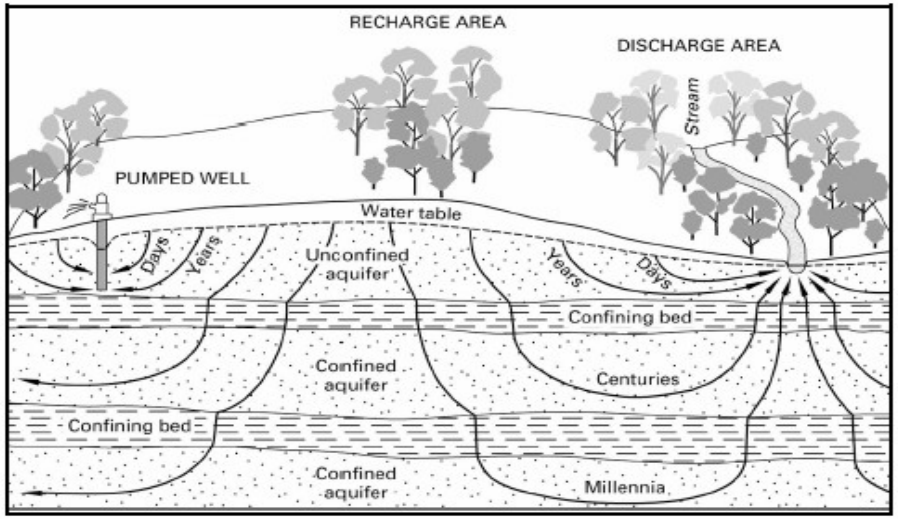


Figure 9. Diagram showing groundwater flow paths of differing lengths and travel times, and their relationship to surface waters and a pumped well.[30]

Newmarket Plains Aquifer

Newmarket's most productive groundwater resource is a stratified drift aquifer generally referred to as the Newmarket Plains Aquifer located in the northwest part of town along Route 152 near Lee Hook Road. The Hazards Map and the Water Resource Map shows the limits of this stratified aquifer as delineated by the US Geological Survey. The surficial area of the aquifer is approximately 410 acres or 0.64 square miles and is about 60 to 80 feet deep at its deepest point.[31] The Newmarket Plains Aquifer represents the Town's

[30] US Army Corps of Engineers, Environmental Laboratory *Subaqueous Capping and natural Recovery: Understanding the Hydrogeologic Setting At Contaminated Sediment Sites*, July 2002, http://el.erdc.usace.army.mil/elpubs/pdf/doerc26.pdf, page 3, July 23, 2009.

[31] Richard B. Moore, *Geohydrologic and Groundwater Quality Data for Stratified-drift Aquifers in the Exeter, Lamprey and Oyster River Basins, Southeastern New Hampshire*, USGS, 1990.

primary source of drinking water from two municipal wells, the Bennett and Sewall Wells. The Bennett Well was installed in 1974 and is 48 feet deep. The Sewall Well was installed in 1985 and is 83 feet deep. These two wells produce high quality drinking water that requires minimal treatment. However, recent studies indicated that the rate of withdrawal from this source and several years of drought conditions resulted in the lowering of the groundwater levels in the aquifer. Recovery of the aquifer after the drought years of the early 2000's has continued, reaching nearly expected capacity today with careful management of water withdrawals. Since the drought, the Town has initiated a water management program (see Section 1-7C.), allowing better control of water use during times of drought or other periods of high demand on the water system.

There are only two other identified stratified-drift aquifer deposits in Newmarket. One exists along Bald Hill Road in the western portion of the town, and the other deposit is situated directly beneath Route 108 and extends from about the Rockingham Golf Course area north to about the railroad crossing. Neither of these deposits are considered to have high water supply potential because these deposits are relatively shallow with depths of less than 20 feet and are also narrow extending out only 300 to 400 feet in width. In addition, the existing development along Route 108 presents a risk of contamination.

B. Bedrock Aquifers

Bedrock aquifers are composed of fractured bedrock or ledge. Groundwater is stored in voids that are created by these fractures. On average, bedrock aquifers tend to yield smaller volumes of groundwater than wells drilled in stratified drift, and finding a sizable enough void or fracture can be a costly procedure.

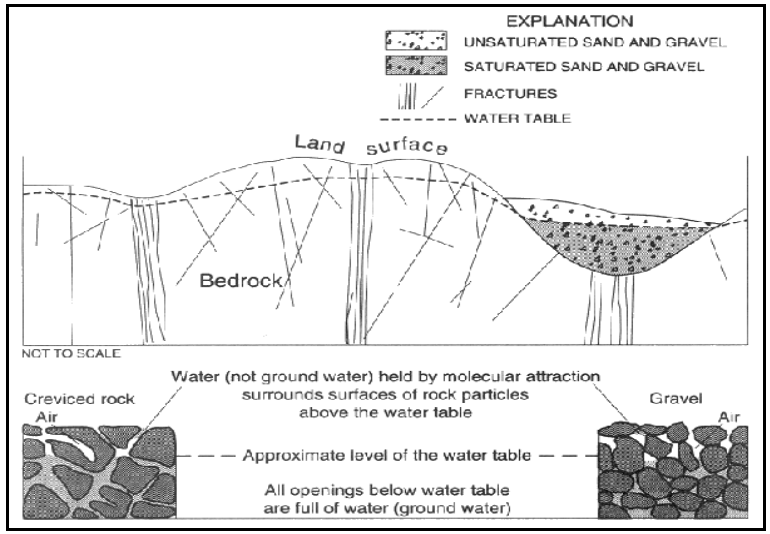


Figure 10. Illustration of fracture systems that store and transmit water in bedrock aquifers [Source: NH DES Environmental Fact Sheet GEO-6 New Hampshire Bedrock Aquifer Resource Assessments]

Areas of Newmarket not covered by stratified drift deposits are underlain by bedrock. Typically most bedrock has variable water yield depending on subsurface conditions (i.e. type of bedrock and the degree of fracturing and connectivity).

C. Local Protection Measures

Aquifers used for public drinking water supplies can be protected using various regulatory and nonregulatory methods including land protection. The most common methods are adoption of protective zoning ordinances and classification of groundwater through the NHDES Drinking Water Source Protection Program (RSA 485-C NH Groundwater Protection Act). A wellhead protection area is the surface and subsurface area surrounding a water well or wellfield supplying a community public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield.[32] The wellhead protection area is determined by the NHDES based on many factors including the type of aquifer material, depth of the well and relative contribution of surface water to the supply.

Aquifer Protection Overlay District
Newmarket Zoning Ordinance Section 5.01 Aquifer Protection Overlay District provides regulatory protection for the Newmarket Plains aquifer and lands adjacent to municipal water wells. The Aquifer Protection District includes all stratified drift aquifers identified in the report entitled *Geohydrology and Water Quality of Stratified Drift Aquifers in the Exeter, Lamprey, and Oyster River Basins, Southeastern New Hampshire* (USGS, Water Resources Investigations Report 88-4128, 1990 revised) in the vicinity of Newmarket Plains along NH Route 152, Lee Hook Road, Lang's Lane, and Ash Swamp Road. The Wellhead Protection District (WHPD) consists of a smaller portion of the aquifer that contributes direct recharge to the Bennett and Sewall wells as identified by the map "Wellhead Protection Area – WHOA Delineation Map" as contained in the report dated October 3, 2006 entitled *Delineation of Newmarket Plains Aquifer Wellhead Protection Area* (Comprehensive Environmental Inc.). The land within the Aquifer Protection District and Wellhead Protection Area are shown on Appendix G - Water Resources Map.

The purpose of the Aquifer Protection Overlay District is to:

- protect, preserve and maintain existing and potential groundwater supplies and related groundwater recharge areas within the town;
- prevent development and land use practices that would increase risk of contamination or reduce the recharge of identified aquifers;
- provide for future growth and development of the town, in accordance with the Master Plan, by insuring the future availability of public and private water supplies; and
- encourage uses that can appropriately and safely be located in the aquifer recharge areas.

The provisions of the Aquifer Protection Overlay district are established to protect the groundwater supply source, one of Newmarket's most valuable resources. Any serious contamination or adverse impact to this aquifer could result in grave consequences to Newmarket's municipal water supply. Ideally, the best protective measure would be to leave this aquifer area in open space and

[32] Water Management and Protection, *Chapter 485 New Hampshire Safe Drinking Water Act: Public Water Supply Protection Program*, http://www.gencourt.state.nh.us/RSA/HTML/L/485/485-mrg.htm, July 23, 2009.

prohibit any development within its limits. However, this would essentially require the Town to purchase outright all land area or at least the development rights to the parcels contained within the Aquifer Protection Overlay District. As other groundwater supply sources are discovered or developed in town, the land area contributing to those aquifers or groundwater resources should be included in the Aquifer Protection District and/or Wellhead Protection District, as appropriate, to protect these resources from future development impacts.

Requirements
Within both protected areas most land uses that involve potentially harmful substances are prohibited. This includes the storage, disposal or handling of any hazardous materials, as well as other materials such as sludge, biosolids, manure, solid wastes, construction materials, and stumps. Industrial uses, automotive repair shops, salvage yards, mining of land are also prohibited. All refueling and vehicle maintenance shall be done, to extent practical, outside the Aquifer Protection District, unless such activity can be completed on an impervious surface or other facility that will contain the spread of an inadvertent spill and subject to approval. For lots with impervious surface coverage in excess of 2,500 square feet or 10% of the total lot area, the planning board and its town-engineering consultant must approve a stormwater management for the site. The maximum development density within the Aquifer Protection District is one dwelling unit per two acres, and one dwelling unit per three acres within the Wellhead Protection Area (WHPA). Within the Aquifer Protection District, a hydrogeologic study shall be required for developments involving the disturbance of more than 50,000 square feet on the same parcel within a period of 5 years.

Non-Conforming Uses and Structures
Existing nonconforming uses may continue and may be maintained, repaired and improved, unless such use is determined to be an imminent hazard to public health and safety by the Town Council or the Health Officer. Nonconforming sand and gravel operations may continue if they are in existence at the time of ordinance adoption and in compliance with all governing local and state regulations (refer to RSA 155-E Local Regulation Excavations). However, new permits for sand and gravel operations in the WHPA must apply for a conditional use permit once the previously approved excavation permit has expired. Mining excavations for such permitted pits, at no time, shall occur below 4 feet above the seasonal high water table (SHWT).

D. State Protection Measures

The NH Department of Environmental Services (DES) recommends a multi-tiered approach to protecting groundwater that includes land conservation for the most sensitive resource areas, prohibiting specific land uses that present high risk for contamination and implementing proper management of hazardous substances. To assist communities with groundwater protection the NH DES has several resources available including:

- Fact Sheet WD-DWGB 22-4: Best Management Practices (BMPs) for Groundwater Protection at http://www.des.state.nh.us/factsheets/ws/ws-22-4.htm
- A model groundwater protection ordinance available at www.des.nh.gov/dwspp/

1-7 MUNICIPAL DRINKING WATER SUPPLY

Policy Statement

Comprehensively protect existing and future drinking water sources and manage these resources to accommodate growth while sustaining them for the future.

A. Public Drinking Water Supply

Existing Municipal Drinking Water Sources

For nearly 40 years, Newmarket has been able to meet its municipal water supply needs with high quality groundwater from the Sewall and Bennett wells located in the Newmarket Plains stratified-drift aquifer and, prior to 1990, from surface waters derived from the Piscassic and Lamprey Rivers.

Sewall and Bennett Groundwater Wells
The groundwater drawn from the Sewall and Bennett wells has required minimal to no treatment, thus making their use highly cost-effective and satisfactory in terms of taste in comparison to other sources, particularly those used in neighboring towns. However, during the drought years in the early 2000's, water levels in the Sewall and Bennett were sustained at extremely low levels. Over the last five years, water levels in the Sewall and Bennett wells have recovered to normal capacity and water use has stabilized due to the Water Management Program now in place. Water levels in these wells have remained nearly constant over the past year as has consumption volumes. These wells are currently pumping an average of 450,00 to 600,000 gallons per day (gpd) with pumping duration between 14-17 hours each day. Refer to Table 20 for annual and daily water production statistics for the Sewall and Bennett wells during the period from 1980 to 2007. With ongoing well development and the aquifer recharge feasibility study underway, additional source water could be available in the near future.

Packers Falls Road Water Treatment Plant
The Packers Falls Road Water Treatment Plant treated surface water withdrawn primarily from Follett's Brook and the Piscassic River for use as a municipal drinking water supply. Originally built in 1924, the facility underwent a major design and equipment upgrade in 1990, at a cost of approximately $2 million. The plant has been idle for the last ten years, except for a short period in 1997, when the interior of the Great Hill storage tank was being repainted. Reactivating the water treatment plant will require significant additional operational and maintenance costs. Preliminarily, the start-up capital costs have been estimated to be around $15,000,000 based on a needed upgrade of the Packers Falls pumping station, which has insufficient pumping capacity to handle the wastewater flow discharged after the backwash cycles. It is uncertain as to whether the plant is in compliance with other Safe Drinking Water Act related regulations that have been adopted since 1990. In 1998, the US EPA adopted an Interim Enhanced Surface Water Treatment and Filter Backwash Rule designed to increase protection against microbial pathogens such as Cryptosporidium. This rule targets small community drinking water systems using surface waters to serve populations of less than 10,000. Due to these fiscal and infrastructure constraints, it is not economically feasible to upgrade the facility so it can be brought back on-line at this time.

Previous Groundwater Source Studies

The Beaudet Farm parcel, consisting of about 162 acres located in the Business (B-2) zoning district, is one of the largest commercially zoned parcels in Town and a potential drinking water source. The Beaudet Farm contains two bedrock test wells that have potential to provide substantial water supply yields based on preliminary well drilling information from more than 10 years ago. If considered further as a public drinking water supply, the Town will need to evaluate steps to protect the water quality of this bedrock aquifer and prevent the potential recharge and water quality impacts from any proposed development. The Town's long-range plans envision that a portion of this property will be developed into a business park. It is located in the Black Bear Tax Increment Financing (TIF) District. If such development occurs, adequate storm water management measures and buffer areas should be implemented as part of the site plan review process to minimize any adverse impacts to this potential drinking water supply and to the water quality of the Great Bay.

Service Connection Statistics

Table 18 shows that new municipal water service connections in Newmarket have increased by 446 from 1997 to 2007, an average increase of 34 new service connections per year.

Table 18. New Municipal Water Connections and Wells Based on Construction Permits from 1997 to 2007
[Source: Town of Newmarket Building Department, 2008]

Year	Single-Family		Apartments/ Condominiums	Municipal Water Connections
	Municipal Water	Wells	Municipal Water	
1997	12	12	3	15
1998	31	30	0	31
1999	29	21	12	41
2000	11	26	5	16
2001	44	27	43	87
2002	39	38	20	59
2003	3	30	100	103
2004	8	15	20	28
2005	6	15	8	14
2006	2	12	12	14
2007	2	1	36	38
Annual average from 1997 to 2007				**34.31**
Total	**187**	**227**	**259**	**446**

Population and Water Production Statistics

Population

The population in Newmarket increased by 5,364 residents over 50 years, from 2,709 in 1950 to 8,027 in 2000. The largest decennial percent change was a 68 percent increase between 1980 and 1990, accounting for over half the total increase.

Water demand is expected to increase in the future as additional households and businesses are connected to the municipal water system, based on results from the USGS study *Methods for and Estimates of 2003 and Projected Water Use in the Seacoast Region, Southeastern New Hampshire* (2007). Refer to Table 26 on page 60 shows projected water demand for Newmarket.

Table 19. Population and Housing Statistics from the US Census Bureau and OEP Estimates

Population	Persons per square mile*	Number Housing Units
1990 Census Data		

7,157	570	3,285
2000 Census Data		
8,027	640	3,457
2007 Census Data Estimates		
9,314	742	4,181

* Total land area = 12.55 square miles

Water Production Statistics

Table 20 on the next page shows that average daily municipal water production from 2000 to 2007 increased by 35% compared with the 1980 to 1989 average and by 5% compared with the 1990 to 1999 average.

The data reported in Table 20 for the period from 1980 to 1984 is not valid when compared with data report from 1985 to the present because, prior to 1984, many service connections had old meters that were highly inaccurate. The Town began replacing the old meters in 1984 and has continued to replace old meters in the years since.

Table 20. Municipal Water Production and Daily Use Averages from 1980 to 2007

Year	Yearly Volume (gallons per day)				Average Daily Use (gallons)	Comments
	Bennett Well	Sewall Well	Municipal Plant	Total Volume		
1980				134,499,000	368,500	
1981				128,353,000	351,650	Old meter at the water treatment plant resulted inaccuracies in the water volume data from 1980 to 1984
1982				121,111,000	331,810	
1983				136,720,000	374,570	
1984				149,065,000	408,400	
1985				173,385,000	475,030	Water plant meter upgraded
1986				163,207,000	447,140	Sewall Well on-line
1987				160,987,000	438,360	
1988	47,143,000	63,169,000	56,429,000	166,841,000	457,100	
1989	59,168,000	64,151,000	52,905,000	176,224,000	482,800	Water plant off-line November 8
Average daily production from 1984 to 1989					**460,086**	
1990	43,671,000	97,814,000	5,897,000	147,382,000	403,790	Water plant on-line in September
1991	67,942,000	56,630,000	25,569,000	150,141,000	411,340	Water rates doubled
1992	69,536,000	69,900,000	6,383,000	145,819,000	399,500	
1993	65,232,000	89,136,000	0	154,373,000	422,940	
1994	67,376,000	98,117,000	0	165,493,000	453,400	
1995	74,687,000	106,201,000	0	180,888,000	495,580	
1996	70,821,000	105,834,000	0	176,655,000	483,990	Storage tank painted
1997	67,041,000	107,110,000	35,767,000	209,918,000		Water plant operated for only 4 months
1998	77,789,000	92,228,000	0	170,017,000	465,800	
1999	76,947,000	89,765,000	0	166,714,000	456,750	
Average daily production from 1990 to 1999					**443,677**	**29% increase from 1980-1989 average**
2000	68,912,000	97,024,000	0	165,936,000	454,620	
2001	69,370,000	100,293,000	13,617,000	183,280,000	502,140	Major waterline leak near Durham side bridge
2002	32,900,000	49,400,000	80,000,000	162,000,000	443,830	
2003	54,400,000	66,400,000	59,700,000	180,000,000	493,150	
2004	50,000,000	62,187,000	51,000,000	163,000,000	446,570	
2005	75,723,000	90,500,000	0	166,223,000	455,400	Water Plant taken off-line permanently
2006	66,328,000	102,740,000	0	169,068,000	436,200	
2007	80,344,000	96,024,000	0	176,368,000	483,320	
Average daily production from 2000 to 2007					**464,404**	**35% increase from 1980 -1989 average** **5% increase from 1990-1999 average**

Public Water Supply Systems

A "Public Water Supply" (PWS) is a system for the provision of piped water for human consumption, and has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. A "Non-transient, Non-community Water system" is a system that serves the same 25 people or more, over 6 months per year, such as schools or private businesses that have their own drinking water supply. A Transient Community Water Supply is a system that serves less than 25 people for less than 6 months of the year, such as at restaurants, campgrounds, and other types of service-related businesses or facilities.[33]

Newmarket has 5 public drinking water wells as described in the Table 21.

Table 21. Statistics of Existing Permitted Public Drinking Water Supply by Type as Delineated by DES [Source: NH DES One Stop Data Site]

EPA #	Site Location	Type	Category	Population Served	Service Connections
1732030	Great Bay Water System, Schanda Dr.	Community	Condominiums	220	87
1738010	Great Hill Maples, Hersey Lane ** Currently not operating*	Non-Community Transient	Restaurant	60	2
1732010	Moody Point, Cushing Road	Community	Condominiums	215	86
1731010	Newmarket Water Works, Packers Falls Road	Community	Major PWS (>1500 served)	5,000	1,933
1732020	Wade Farm Condos, Dame Road	Community	Condominiums	40	16

Approximately 1,649 acres of land are contained within the wellhead protection areas for public drinking water supplies. Newmarket has 469 private drinking water wells registered with the NHDES Drinking Water Protection Program water well database, which reports only new private wells drilled and registered from 1984 to the present.

Table 22. Well-head Protection Areas for Public Drinking Water Supplies (Active Areas only) [Source: NH DES, Well-head Protection Areas 2009 GIS data layer]

Type	Protected Area (acres)	% Total Municipal Area
Community	1,649.1	18.2

Role of Water Conservation Plans

[33] Water Management and Protection, *Chapter 485 New Hampshire Safe Drinking Water Act: Public Water Supply Protection Program*, http://www.gencourt.state.nh.us/RSA/HTML/L/485/485-mrg.htm, July 23, 2009.

Conservation Planning

Setting Goals. Water utilities should specify water conservation planning goals in terms of expected benefits for the water system and its customers. Lowering water demand can help water suppliers avoid, downsize and postpone the construction and operation of new supply facilities. Water conservation reduces demands on both private and municipal wastewater systems, and can benefit customers and utilities by lowering energy and long-term costs. The need to reduce current and to control future wastewater treatment costs can be a strong rationale for implementing water conservation planning. Water conservation planning goals may include:

- Eliminating, downsizing or postponing the need for new and future capital projects
- Improving the utilization and extending the life of existing facilities
- Lowering variable operating costs
- Avoiding new source development costs
- Improving drought and emergency preparedness
- Educate customers about the value of water resources
- Improving reliability and margins of safe and dependable source yields
- Protecting and preserving environmental resources

Community Involvement. Involving the community in goal development and implementation serves as an important public education function, and can greatly enhance the success of conservation programs. Ongoing involvement helps maintain and build support for achieving conservation goals and spreading the word about conservation efforts. Community representatives can provide contacts with key groups – consumers, businesses, and other users – whose involvement may be key to implementing and sustaining certain conservation measures.

Develop a Water System Profile. Developing a system profile by taking inventory of existing resources and conditions helps water utilities assess their present conditions and/or problems and design strategies to meet needs. A profile contains: 1) a summary of the service and operating characteristics of the water system, and 2) an overview of conditions and a description of climate, water availability, sources, and other factors that might affect water conservation planning.[34]

Conservation Measures

The document "Guidelines for Preparing Water Conservation Plans" (EPA, 1998) describes the water conservation measures that water utilities can use in designing water conservation programs. Water utilities are strongly encouraged to explore the fullest range of conservation measures practical, and to consider as many measures as practical given their capability and the conditions they seek to address. The recommended measures are organized into three general categories as follows:

Level 1 Measures	Level 2 Measures	Level 3 Measures
Universal metering	Water use audits	Replacements and promotions
Water accounting and loss control	Retrofits	Reuse and recycling
Cost and pricing	Pressure management	Water use regulation
Information and Education	Landscape efficiency	Integrated resource management

[34] US Environmental Protection Agency, *Guidelines for Preparing Water Conservation Plans*, 1998, http://www.epa.gov/WaterSense/docs/part5_508.pdf, July 23, 2009.

Water utilities can promote the development of water conserving principles into the planning, development and management of new landscape projects such as public parks and golf courses. Utilities can promote low water-use landscaping by residential and commercial customers, especially those with large properties. Additionally, water utilities can promote new technologies including fixtures, appliances and landscape water devices.

Water Loss
Water audits provide public water suppliers with an effective means of identifying and reducing water and revenue losses and making better use of water resources. The primary goal of a water audit it to help the public water supplier select and implement programs to reduce water system losses. Regular leak detection survey programs provide critical information on water system losses, making them an essential component of effective water system management. Detecting and repairing leaks can provide one of the largest cost savings, especially in older systems.[35]

Water Meter Replacement
Comprehensive water system metering ensures that water suppliers are compensated for the water they provide, without lost revenue from unmetered or inaccurately metered water. Accurate metering enables the public water supplier to bill customers more accurately based on actual use, obtain data on customer use patterns, and obtain data useful in water demand management programs such as water audits and water conservation. Water use data can assist the water supplier in identifying potential water savings measures to reduce overall systems costs as well as demand. Local water use data is also helpful for managing water resources regionally and statewide.[36]

Public Education and Outreach
The components recommended for an effective educational program include information on:

- environmental benefits of keeping water local and reducing water demands (connection to surface water and groundwater in maintaining stream flows for water quality, wildlife and aquatic habitat and water recreation)
- water conservation helps water quality
- investments in efficiency and conservation provide water users with long term savings compared to the cost of developing new systems and sources
- costs to all water users involved in providing water (planning, engineering, construction, operation, maintenance, protection, staff)

[35] Massachusetts Executive Office of Environmental Affairs and Water Resources Commission, *Water Conservation Standards*, July 2006, http://www.conservewatergeorgia.net/resources/MA_Conservation_Standards_2006.pdf, page 10, July 23, 2009.
[36] *ibid.*, page 13.

B. Municipal Drinking Water Supply Distribution Systems

Existing Infrastructure

The Water and Sewer Division of the Town of Newmarket has five employees: Superintendent Water and Sewer, Laboratory Technician, Maintenance Supervisor, System Technician, and a Water Operator. All personnel have the required certification in varying degrees from the New Hampshire DES for treatment plant operation, laboratory, collection system, and water treatment and distribution.[37]

The water system currently pumps approximately 500,000 gallons of water a day from the Bennett and Sewall wells, located in the plains area off Wadleigh Falls Road. The distribution system consists of a 750,000-gallon water tank, approximately 22 miles of 6 to 16 inch diameter water line, 222 hydrants, and a booster station located on Folsom Drive.

The Water Treatment Plant is currently off-line due to its inability to meet federal Safe Drinking Water Act standards. The plant was shut down in 2004 after it was determined that an extensive upgrade would be required to meet new and pending regulations.

Infrastructure Capacity Limitations

At this time, expansion of the existing municipal drinking water supply is limited by two factors: capacity of the existing storage and delivery infrastructure, and maximum sustainable well yield.

Table 23. Limitations of Municipal Drinking Water Supplies on Production and Demand

Infrastructure	Limitation
Well Pump Capacity	Established best practice to maintain adequate minimum water level in wells is a maximum yield of 670,000 gallons per day
Storage Tank Level	A minimum water level must be maintained in the storage tank to provide adequate pressure for distribution to customers at elevations higher than the tank itself
Storage Tank Volume	Storage tank volume must accommodate volume for daily maximum usage and minimum tank level requirement; storage tank volume turnover is 1.5 days
Distribution System	Lack adequate storage tank capacity to perform flushing of lines for maintenance purposes and maintain volume for daily maximum usage
Aquifer Capacity	Maximum pump capacity is set according to safe well yield estimates maintain adequate minimum water level in wells
Ways to Maintain and Improve Capacity	
Water Conservation Program	Water volume conserved through voluntary restrictions has not been evaluated
Water Loss	Measurement>> Water Production - Water Use = Water Loss Water loss is due to leaking distribution lines and unmeasured water usage by old/inaccurate meters
Meter Replacement and Calibration	New meters are highly accurate and provide better records and usage measurement. After determining the accuracy of metering systems, the utility should provide a schedule of activities necessary to replace meters or correct meter deficiencies.

[37] Sean Greig, Newmarket Water and Sewer Division, email confirmation, July 14, 2009.

Future Infrastructure Improvements

The report *Water Storage and Distribution Improvements: Preliminary Design Report*[38], included recommendations for improvements to the drinking water storage and distribution system in order to achieve the minimal recommended fire flow capacity of 750 gallons per minute.

C. Water Management Program

The Town is fortunate to have adequate groundwater resources that serve as the primary source for both public and private drinking water wells. The Newmarket Water Department strives to improve the water quality and water quantity of its drinking water supply. The Newmarket Plains aquifer underwent a period of drought in the late 1990's. During the dry summer months aquifer capacity was significantly reduced; however, with careful management the aquifer had recovered within several years. To accomplish this the Town implemented a Water Management Program in 2002.

For a Water Management Program (Ordinance No. 2002-05) to succeed all users must adhere to restrictions and guidelines to conserve groundwater resources during critical dry months. The program consists of a four-stage system requiring water users to limit water consumption to maintain adequate volume of the available water supply. Currently, the town is operating at Stage 2 and has since 2007.

Table 24. Newmarket Water Management Program Four Stage System

Stage 1 **Voluntary Water Conservation**	The public is requested to refrain voluntarily from watering lawns and encouraged to conserve water in all practical ways.
Stage 2 **Mandatory Odd/Even Outside Watering**	The public is required to restrict lawn watering to every other day based on address and calendar day (even address = even calendar day, odd address = odd calendar day)
Stage 3 **Mandatory Two-Day Restrictions on Lawn Watering by Address**	Each address is to restrict watering to two (2) days per week between the hours of 5-8am and 6-9 pm on the following schedule: Allowed Days: Monday, Wednesday = Odd Number Street Address Tuesday, Thursday = Even Number Street Address No washing driveways, sidewalks, autos or boats.
State 4 **Mandatory Outside Water Ban**	The public is required to restrict the following: NO OUTSIDE WATER USE
Note: Hand held hoses might be used for flower and vegetable gardens and shrubbery without hour and day restrictions during State 2 and Stage 3 only.	
Public Notification: Implementation of Water Management Program Stages are posted at locations entering Town, on the Town Hall marquee, and in local newspapers.	

[38] Underwood Engineers, Inc., *Water Storage and Distribution Improvements: Preliminary Design Report*, June 21, 2006.

The Water Management Program encourages public drinking water users to implement the following water saving measures in the homes and/or business:

1. Check toilet, faucets and pipes for leaks.
2. Install water-saving showerheads or flow restrictors.
3. Use dishwaters and washing machines for only full loads.
4. Keep a bottle of drinking water in the refrigerator to avoid running the tap.
5. Water your lawn only when necessary, and during cooler times of the day.
6. Avoid washing driveways, gutters and walkways.
7. Plant drought-resistant species of trees, shrubs and plants.
8. Put a layer of mulch around trees, shrubs and plants to retain moisture.
9. Cover swimming pools to reduce evaporation.

D. Future Municipal Drinking Water Supplies

Groundwater Source Investigations

In 2006, the Town contracted with Emery & Garrett Groundwater, Inc. to conduct a town-wide exploration program to locate potential drinking water supply sources from bedrock and/or unconsolidated sand and gravel aquifers within the Town. The options currently being studied are: 1) development of new groundwater supply wells, and 2) use of artificial recharge to enhance water resources derived from existing sand and gravel wells. The investigation included the following work phases:

Phase I Identify sub-areas that are considered to have the greatest potential for acceptable water quality.
Phase II Select specific exploratory test well sites surveys and detailed geologic mapping.
Phase III Drill selected test wells and conduct preliminary hydrologic testing.
Phase IV – Install a large diameter production well(s).
Phase V Test the production well(s) to assess sustainable yield and quality of local aquifers.

The Phase I investigation identified six Primary Groundwater Development Zones and two Secondary Zones, which are considered hydrogeologically favorable for developing groundwater supplies. Two of these well sites – NGE-1 and NGE-2 – were selected for further source water development.

The Phase II investigation included selection of exploratory well sites through the use of geophysical surveys within the Groundwater Development Zones NGE-1, NGE-2, NGE-3, and NGE-7. In addition, exploratory test well drilling was conducted within Zones NGE-1 and NGE-2. The results of this testing led to the selection of two production wells in south-central Newmarket that are considered favorable for the development of substantial volumes of potable drinking water supplies from bedrock aquifers – well #3 (NGE-1A) and well #4 (NGE-2B). The results of the preliminary testing suggests that the new production wells can serve as a municipal groundwater supply potentially capable of producing a maximum combined yield of up to 600 gallons per minute (gpm) or 864,000 gallons per day (gpd).

Their report *Preliminary Hydrogeologic Investigation-Town of Newmarket-Groundwater Development-Production Wells #3 (NGE-2B) and #4 (NGE-1A)* has been submitted to the NH Department of Environmental Services (NHDES) Drinking Water and Groundwater Bureau for approval. The Town is currently in negotiations with the landowner for the sale or easement of

land for well site NGE-2B so that development of the well can move forward. The Town seeks to protect the land around well site NGE-1A for future development of source water. The Town is in the permitting process for a NHDES Groundwater Withdrawal for the project. This summer they will be completing water pump tests for the two bedrock wells. The Town continues to negotiate with landowners for the sale and/or easement of land for well site NGE-2B.

Aquifer Recharge Project

The Town of Newmarket first used artificial recharge on their Newmarket Plains Aquifer in 2002, during a period of drought. At that time over-pumping had caused the Town's two gravel packed wells to draw water levels to dangerously low levels. The Town was using the water treatment plant on the Piscassic River as a supplementary source of supply, and in order to optimize its operation, excess water from the plant was used to artificially recharge the aquifer near the Bennett Well. Hydraulic aspects of the recharge worked well, but water quality pumped from the well failed tests for disinfection byproducts, a legacy of the difficulty of filtering and removing organic compounds from Piscassic River water. Following a review of results, the practice of artificial recharge was abandoned.

The Town had contracted the firm Emery & Garrett Groundwater, Inc. to complete a study to see if water from the cleaner Lamprey River could be used instead to artificially recharge the aquifer. Water quality tests of a system involving the passage of Lamprey River water through aquifer sands suggest that it can. Negotiated arrangements with the Town of Lee would have allowed for water to be piped from the Lamprey close to the aquifer. Monitoring wells have been installed and a groundwater flow modeling study has been completed in order to determine how much water could be pumped from the river to recharge basins a few hundred feet from the well. Water was to be pumped for recharge during winter months, at a rate of less than one cubic feet per second, causing no noticeable change in river flow. Natural filtering of river water through aquifer sands would provide excellent water quality at the well, and the well's sustainable yields was expected to increase significantly.

Currently, the recharge project has been put on hold. There are no guarantees if this project will be pursued in the future, but there have been discussions about additional funding that may be available in the upcoming years.

E. Projected Water Demand Based on Growth

Previous Projections of Demand

2004 Projections
The purpose of a 2004 study conducted by Metcalf & Eddy was to estimate water system demands through 2025. The study included the following:

- ✓ Review of historical population data to estimate growth trends
- ✓ Review of historical water consumption and production data to determine statistics of usage relative to land use
- ✓ Estimate of the Town's water demand requirements based on evaluation and extrapolation of historical data

The study reports that of the total municipal water usage, 75 percent was from residential development, 10 percent was from non-residential development (includes commercial, industrial, municipal, and seasonal users), and 10 percent was from lost (unaccounted for) water. Estimated per capita consumption in Newmarket was approximately 77 gallons per capita per day (gpcd) based on historical data, production data, and unaccounted for water volume of approximately 10 percent of production.

Based on projected population growth and associated water consumption increases, the study estimated future water system demands as summarized in Table 25 below.

Table 25. Projected Average and Maximum Daily Water Demand and Associated Water Consumption from 2005 to 2025 Based on Projected Population Growth

Year	(gallons per day)		ADD* (gallons)		
	ADD*	MDD*	Residential	Non-Residential	Lost Water
2005	501,765	903,177	376,324	75,625	50,177
2010	535,040	963,072	401,280	80,256	53,504
2015	584,155	1,051,479	438,116	87,623	58,416
2020	635,140	1,143,252	476,355	95,271	63,514
2025	671,000	1,207,800	503,250	100,650	67,100

*ADD = Average Daily Demand MDD = Maximum Daily Demand

2006 Projections
A 2006 study by Underwood Engineers, Inc. indicated that the Town of Newmarket's average daily production rate of water supplies was approximately 468,000 gallons per day during the period from 2000 to 2005. This study also indicated that the average daily production rate for water use would reach 535,500 gpd by the year 2020, and the maximum production rate required in year 2020 will be 851,500 gpd.

2008 USGS Seacoast Region Groundwater Study

The study *Methods for and Estimates of 2003 and Projected Water Use in the Seacoast Region, Southeastern New Hampshire* (2007) reports that, in 2003, domestic water demand was 19.0 million gallons per day (includes domestic consumptive use of 3 millions gallons per day) and non-domestic water demand was 7.3 million gallons per day.

The study concludes that domestic water demand would increase 54 percent to 28.7 million gallons per day from 2003 to 2025 and non-domestic water demand is projected to increase by 62 percent to 11.8 million gallons per day from 2003 to 2025 based on projections of future population growth. [39]

Table 26. Actual and Projected Domestic Water Demand in Newmarket from 2003 to 2025[40]

Water Demand (gallons per day)			Percent Growth	
2003	**2017**	**2025**	**2003-2017**	**2003-2025**
591,000	1,103,000	1,161,000	87	97

[39] Marilee A. Horn, Richard B. Moore, Laura Hayes, and Sarah M. Flanagan, *Methods for and Estimates of 2003 and Projected Water Use in the Seacoast Region, Southeastern New Hampshire*, USGS Scientific Investigations Report 2007-5157, http://pubs.usgs.gov/sir/2007/5157/pdfs/sir2007-5157.pdf, July 23, 2009.
[40] *ibid.*, page 60

Table 27. Estimated Domestic Water Demand, Return Flow and Sewer Flow in Newmarket for 2003[41]

Population			Domestic Water Use			
Total	**# Septics**	**% on Septic**	**Total Demand**	**Return* Flow**	**Sewer Flow**	**Consumptive Use**
8,027	2,383	30	591,000	137,000	368,000	85,000

*Return flow includes hydroelectric, thermoelectric, irrigation, mining and agricultural users.

New Connections and Expansion of the Municipal Water Service Area

It is important to note that much of the growth in Newmarket has occurred outside the municipal water service area. Single-family homes consume more water on an average daily basis than condominiums and apartments.

Based on the data reported in Table 18, a total of 446 new connections were made to the municipal water supply from 1997 to 2007, with an annual average of 34 new connections. Of these new connections, 259 connections were for apartment and condominiums and 187 connections were for single-family households. The highest annual number of new connections occurred from 2001 to 2003.

During the period from 1997 to 2007, 227 new private wells were installed, with an annual average of 20 new wells.

[41] *ibid.*, page 36

1-8 POTENTIAL THREATS TO WATER RESOURCES

Policy Statement

Protect water resources from pollution and degradation to maintain critical functions, benefits and ecological integrity of these resources.

A. Point Source Pollution

National Pollution Discharge Elimination System (NPDES) Permits

The term point source generally refers to any industrial or municipal sanitary wastewater discharge from an outlet pipe. These types of discharges must obtain a permit under the EPA National Pollution Discharge Elimination System (NPDES), which are generally reissued every 5 years and have specific monitoring and reporting requirements.

Currently, the Town holds two NPDES discharge permits. The Newmarket Wastewater Treatment Facility discharges into the Lamprey River below the Macallen dam and the water treatment plant intake (EPA NPDES No. NHG640007). The Town is currently completing work to address an EPA Administrative Order that was issued in 2004. Recently items addressed from that order include the completion of an inflow and infiltration study for the Town which identified the need to implement repairs throughout the collection system, upgrade the sewer system in New Village; and design modifications to the Wastewater Treatment Plant to address water quality standards including the removal of total nitrogen.

The town's second NPDES permit is for discharge of process water from the Water Treatment Plant. This permit is currently inactive as the treatment plant is no longer operational.

Upstream of Newmarket, the Town of Epping also holds a permit to discharge treated municipal wastewater into the Lamprey River.

Newmarket Wastewater Treatment Plant

The Water and Sewer Division of the Town of Newmarket consists of the same five employees who are responsible for the operation of the drinking water supply for Newmarket. The staff is responsible for the safe operation and maintenance of the Wastewater Treatment Facility, Creighton Street pumping Station/ Head-works and the following pumping stations: Bay Road, Cedar Street, Salmon Street, Packers Falls Road, and Wadleigh Falls Road. The system includes approximately 900 manholes with 27 miles of 6 to 24 inch gravity sewer and approximately 1.8 miles of force mains.

Newmarket's wastewater system was evaluated and described in the Draft 201 Facilities Update Report prepared by Underwood Engineers, Inc. (January 14, 2000). The report states that the average daily flow to the plant is nearing the plant's capacity. During storm events wastewater flow often exceeds capacity, resulting in overflow and the discharge of partially treated

wastewater. The engineers recommended that the plant capacity be upgraded from 0.85 mgd to 1.25 mgd by 2020. The study found, that not only has increased development in the town contributed to increased sanitary flows, but also due to the fact that several sewer segments are upwards to 100 years old, higher than normal amounts of groundwater are infiltrating into the system. This infiltration unnecessarily uses up the system capacity and causes a greater frequency of overloads.

Recently, the Town has contracted with Underwood Engineers, Inc. to complete an inflow and infiltration study with recommendations to improve the system. The Town is currently working on a project to replace water, wastewater and drainage systems in New Village areas.

B. Non-Point Source Pollution

Non-point pollution sources primarily consist of the diffuse and intermittent flow of stormwater runoff from impervious surfaces and other land use activities containing contaminants that could influence the quality of surface waters and wetlands. Non-point pollution sources can include other non-stormwater related sources such as leaking storage tanks or improperly designed or malfunctioning septic systems. In general, surface waters, wetlands and stratified drift aquifers become increasingly more vulnerable to non-point source pollution as development density and impervious surfaces increase. These changes to the land surface can result in greater volumes of runoff and less pollutant removal from naturally vegetated areas. Bedrock aquifers tend to be somewhat more protected in areas where covered by a thick soil layer and dense vegetation that filter out many contaminants. However, in areas where bedrock crops out at the land surface or where thin soil and sparse vegetation conditions exist, non-point source pollution has a more direct path to enter groundwater and impair water quality.

The most recent statewide Non-point Source Management Plan was published by NHDES in 1997. The Plan identifies and ranks fifteen categories of Non-point Pollution Sources (NPS) that warrant additional attention, education and treatment measures to abate or minimize their potential harmful effects on aquatic resources. Table 28 lists the NPS categories, in order of priority, based on a combination of several factors. These factors include potential dangers to public health, magnitude and pervasiveness of the potential threat, potential impacts to receiving waters, professional judgment, ability of existing regulatory programs to control pollution, adequacy of existing educational programs to promote pollution control, and public perception.

Table 28. List of Fifteen Categories of Non-point Pollution Sources (NPS) with Potential to result in Harmful Effects to Public Health and Aquatic Resources

Rank	Category
1	Urban Runoff
2	Hydrologic and Habitat Modifications
3	Subsurface Systems (septic systems)
4	Junk, Salvage, and Reclamation Yards
5	Construction
6	Marinas
7	Road Maintenance
8	Unlined Landfills
9	Land Disposal of Biosolids
10	Land Disposal of Septage
11	Agriculture (hobby and commercial)
12	Timber Harvesting
13	Resource Extraction
14	Storage Tanks (above/below ground)
15	Golf Courses and Landscaping

Stormwater Runoff

Stormwater is generated by precipitation, surface runoff and snow melt from land, pavement, building rooftops and other impervious surfaces. The Complex Systems Research Center at the University of New Hampshire conducted a study titled *Impervious Surface Mapping in Coastal New Hampshire* (2006)[42], which was sponsored by PREP. This study evaluated impervious surface coverage and population trends from 1990 to 2005 for communities in the coastal watershed. As shown in Table 29 below, impervious surface coverage for Newmarket has

[42] David Justice, Fay Rubin, *Impervious Surface Mapping in Coastal New Hampshire 2006*, Complex Systems Research Center at the University of New Hampshire, http://www.nhep.unh.edu/resources/pdf/impervious_surface_mapping-unh-06.pdf, July 23, 2009.

increased steadily since 1990 to the present with an overall increase since 1990 of 321.1 acres or 64.5 percent.

Table 29. Impervious Surface Coverage from 1990-2005
[Source: Complex Systems Research Center at the University of New Hampshire, *Impervious Surface Mapping in Coastal New Hampshire* (2006)]

Year	1990	2000	% Increase 1990-2000	2005	% Increase 2000-2005
Impervious Surface Cover (acres)	497.7	706.6	---	818.80	---
% Total Municipal Area	5.9	8.8	32.9%	10.1	44.7%

Today, the estimated current total impervious surface coverage of 10.2 percent is close to approaching a critical threshold for the protection of surface water quality. Studies conducted in the northeast have documented that by converting as little as ten (10) percent of a watershed to impervious surfaces, stream water quality, stream channel structure, and species habitat begins to deteriorate. The Center for Watershed Protection (Ellicott City, Maryland) reports similar findings of the correlation of percent impervious surface coverage with degradation of water quality and in-stream habitat. Above 25 percent impervious surface, water quality is seriously degraded. The 2005 report titled *The Effects of Urbanization on Stream Quality at Selected Sites in the Seacoast Region in New Hampshire, 2001-03*[43], found sites with greater than fourteen (14) percent impervious surface in the watershed generally showed changes in stream quality as measured by reductions in the combined water quality, habitat condition and biological condition score.

Low Impact Development
Changes in land cover, resulting in replacement of natural vegetation with hardened surfaces, translates into an increase in stormwater runoff (volume and rate), an increase in non-point source pollution, and a reduction in groundwater recharge. Low Impact Development (LID) is a technique of developing land in a manner that mimics the natural hydrologic functions on the developed landscape. LID methods combine site design strategies and best management practices to achieve this primary goal. The goal of LID is to reduce the volume and flow of runoff from the developed site and to treat and recharge precipitation in a way that mimics the natural hydrology of the site and maintains high water quality.

Hydrology and Natural Resources
LID helps to manage the impacts that stormwater runoff has on wetlands, streams, lakes and coastal environments, and recharge natural groundwater aquifers. Under natural conditions, rainfall and surface runoff infiltrates into the ground, recharges the groundwater aquifers and provides base flow to streams, rivers and wetlands. Another significant portion of rainfall is cycled back to the atmosphere through evapotranspiration, a combination of evaporation from the ground and vegetation surfaces and the natural process of transpiration that occurs in plants. The remainder of rainfall is converted to runoff and flows into surface waters.

[43] Jeffrey R. Deacon, Sally A. Soule, *Thor. E. Smith, Effects pf Urbanization on Stream Quality at Selected Sites in the Seacoast Region in New Hampshire, 2001-03*, NH Department of Environmental Services, http://pubs.usgs.gov/sir/2005/5103/, July 23, 2009.

Development changes the natural water balance on a site by:

- increasing impervious area and reducing the amount of ground area capable of infiltration,
- converting naturally vegetated areas to impervious or manicured areas, and
- compacting natural soils.

Development also traditionally connects impervious areas to create efficient pathways to convey and divert runoff where it often terminates in direct discharges to surface waters. This creates the following:

- hydrologic changes:
- larger volumes of runoff than under natural conditions,
- less recharge to groundwater and flow to surface waters and wetlands, and
- higher peak flow rates than under natural conditions.[44]

Better Site Design.

An important concept related to Low Impact Development is the concept of "Better Site Design". Better site design is a set of related tools that help to reduce the environmental footprint of a development on the site, and helps to reduce the need for stormwater management techniques. Better site design includes techniques such as maintaining natural vegetated areas and reducing manicured lawn areas, maintaining or planting native vegetation that is more hearty and requires less irrigation and fertilizer than non-native species, reducing pavement size by reducing driveway and roadway lengths and widths, reducing unnecessary sidewalks, building up rather than out to reduce building footprint, and avoiding natural resource areas such as wetlands, springs, wellhead areas, or special habitat areas.[45]

Impervious Surfaces.

Impervious surfaces are defined as materials that prevent or significantly retard the infiltration of water into underlying soil or earth materials. Conventional development can create large areas of impervious surfaces in the form of rooftops, driveways, parking areas, walkways, patios and roadways, and often results in significant reduction in forest or other natural vegetated land cover to accommodate the development and the construction process. Low Impact Development (LID) differs from conventional development because it focuses primarily on site design with the goal of maintaining the natural water balance. This is done by retaining as much of the natural vegetative cover on a site as possible and siting of buildings, driveways and parking areas in a way that avoids and minimizes impacts to wetlands, surface water, source water protection and recharge areas, and other important hydrologic features. Once the basic site design is created, LID practices can be integrated into the design to further improve stormwater management to reduce the pollutant load carried in the stormwater, reduce erosion, peak flows, and runoff volumes, and increase infiltration on the site to maintain hydrologic function and a more natural hydrologic system.[46]

Erosion and Sedimentation

[44] Horsley Witten Group, *LID Manual for Maine Communities: Approaches for implementation of Low Impact Development Practices At The Local Level,* Maine Coastal Program, 2007, http://www.maine.gov/dep/blwq/docwatershed/materials/LID_guidance/manual.pdf, page 2, July 23, 2009.
[45] *ibid*., page 3.
[46] *ibid.*, page 4.

The development process typically involves the removal of vegetation, the alteration of topography, and the covering of some previously vegetated surfaces with impervious cover such as roads, driveways, and buildings. These changes to the landscape may result in the erosion of soil and the sedimentation of water bodies as soil travels to streams, rivers, and lakes in water runoff during storms at an increased velocity due to the lack of vegetative cover. The removal of vegetative cover and its roots system compromise the ability of vegetation to stabilize soil, reduce the velocity of runoff, shield the soil surface from rain, and maintain the soil's ability to absorb water. Specific erosion and sedimentation impacts related to the loss of vegetation, pollution of the water supply, and alteration of topography are:

- Streambank erosion caused by an increase in stormwater runoff. Eroded material may affect aquatic habitats and alter aquatic species' life cycle events by increasing turbidity, changing the water temperature, and changing the depth of waterbodies.
- Alteration of existing drainage patterns. This may affect abutting properties and roads, as well as waterbodies.
- Destabilization of steep slopes. Removal of trees and other vegetation may lead to erosion of soil on steep slopes.
- Reduced potential for groundwater recharge due to coverage by impervious surfaces or drainage control methods that take stormwater off-site.
- Runoff of chemicals into water supplies. Petroleum and other chemicals on construction sites may be included in non-point pollution that drains to water supplies during storm events.
- Runoff of nutrients into water supplies. Nitrogen and phosphorus concentrations in surface waterbodies can be dramatically increased by increased stormwater runoff resulting in accelerated eutrophication and the proliferation of non-native aquatic plant species.

There are several structural and non-structural methods and management and planning techniques that may be used to control erosion and sedimentation during the site development process. Methods used during construction are meant to manage the increased amount of erosion and sedimentation that occurs as a result of grading and other land disturbance short-term activities during construction, and are not designed to be permanently in place. When properly installed these methods can be effective in preventing the erosion and sedimentation that may occur during construction, especially during storm events. These methods include: developing work zones and establishing phases of construction; developing the sequence of construction and methods to be used during the phases; preparing a schedule for earth moving and building construction activities; requiring a narrative of daily activities. When these steps are completed, an erosion and sediment control plan can be created utilizing practices that will support the daily schedule of construction activities while preventing erosion and controlling sediment movement to waterbodies. As part of the phasing step, plans should be developed for removal and retention of vegetation and trees during development and replanting following development.

Erosion and sedimentation control methods used on a development site can include one or more of the following techniques: compost filter sock and mulching; vegetated buffer strips; grassed swales; detention ponds; constructed wetlands; stabilization of steep slopes; infiltration structures

and practices; silt fence and hay bale barriers; stone check dams; and proper phasing of land alteration and clearing.[47]

Road Salt and Maintenance

The salting of roads in winter is a non-point source of pollution. Chloride in the form of salt is imported to local watersheds from several major sources: roadway deicing, snow removal, food waste, water softeners, atmospheric deposition, and roadway salt pile runoff. Chloride is most commonly transported within a watershed through stormwater runoff and groundwater flow to surface waters. Year to year variations in chloride contribution is primarily due to differences in the severity of winter in a given year.[48]

Best management practices for minimizing pollution include covering salt piles, loading salt trucks on paved areas, and the use of modern salt application equipment. Excessive use of road salt can unnecessarily contaminate water. Careful judgment when applying road salt minimizes contamination of surface waters and wetlands.

Underground and Aboveground Storage Tanks

Leaking underground storage tanks (USTs) and aboveground storage tanks (ASTs) have historically been a significant nonpoint pollution source due to the corrosion of the older steel tanks. However, because of more stringent design, testing and monitoring requirements imposed by NHDES in recent years, most of these older steel tanks have been removed and replaced by fiberglass-composite tanks that are less prone to corrosion. Aboveground tank regulations also require secondary containment, spill containment and overfill protection using level gauges and in many cases high-level audible alarms.

A list of the location and type of the active USTs and ASTs in Newmarket can be obtained on the NHDES One-Stop Data Retrieval website at http://www.des.state.nh.us/OneStop.htm. Newmarket has 23 underground storage tanks listed (2 residential, 9 commercial/business, 7 municipal/state/federal, and 5 gas/service station) and 4 aboveground storage tanks (2 municipal, 1 utility and 1 commercial/business). Since the 1994 Master Plan update, many of the older tanks associated with many older businesses in Newmarket have been removed. These tank removals represent a significant reduction in the threat of contamination from petroleum products since many of these former tanks were 30 to 40 years old, which is well beyond the typical design life of steel tanks.

Hazardous Waste Generators

A list of the location and type of hazardous waste generators in Newmarket can be obtained on the NHDES One-Stop Data Retrieval website at http://www2.des.state.nh.us/OneStop/. There are currently 72 hazardous waste generators in Newmarket.

[47] NH Department of Environmental Services, *Innovative Land Use Planning Techniques Guide: Chapter 2: Environmental Characteristics Zoning – Erosion and Sediment Control,* Regional Environmental Protection Program (REPP), 2007.

[48] NH Department of Environmental Services, *Total Maximum Daily Load (TMDL) Study For Waterbodies in the Vicinity of the I-93 Corridor from Massachusetts to Manchester, NH: Beaver Brook in Derry and Londonderry, NH,* April 18, 2008.

Table 30. Hazardous Waste Generators Reported by NHDES in Newmarket

Type of Activity or Use	Activity Status			
	Active	Inactive	Declassified	Non-notifier
Residential	0	5	0	0
Municipal/State/Federal	2	9	1	0
Commercial/Business	9	30	5	1
Gas/Auto Service Station	3	7	0	0

Active - an active EPA ID number to permit generation of hazardous waste.

Inactive – the site at one time had an active EPA ID number and may or may not have generated hazardous waste but are not currently. The operator has the option to reactivate the EPA ID number if needed in the future.

Declassified – the company moved out or shut down operations, no HW is being generated.

Non-Notifier - HW Waste was picked up at this site. They do not have an active EPA ID number. The waste was manifested by a HW transporter and we get copies of all shipments. We now follow up with the site to see what type of activity is going on there and if they need a number and be brought on line.

C. Local Protection Measures

Currently, the Planning Board can require additional stormwater treatment measures such as oil/water separators for parking lots and other paved surfaces in close proximity to the Lamprey River, Piscassic River, Great Bay or other areas of concern as stated in Section 3.07 of Newmarket's Site Plan Review Regulations.

- The Planning Board should take a more focused effort to require such measures particularly for proposed commercial projects near these waterways. This includes the proposed redevelopment of the mills, given the close proximity to the river, where treatment devices such as catch-basins with sediment sumps and oil/water separators or other similar manufactured treatment technologies should be included in the drainage design.

To further protect water quality, the Town may want to encourage certain regulatory restrictions including:

- Promote a broader use of vegetative buffer areas or structural setbacks from sensitive wetlands and along major tributaries to maintain the functions and benefits of these systems.

Newmarket requires a minimum of a 125-foot setback for septic systems along shoreline areas of the Piscassic River and Follett's Brook (the State requires a septic system setback of 75 feet from surface waters).

- The Lamprey River Advisory Committee has advised that the septic system setback be increased to 150 feet along shoreline areas of the Lamprey River. This recommended setback distance would affect limited areas in Town including areas along the tidal portion of the Lamprey River such as New Road, Smith Garrison Road, Moody Point, properties along the west side of Route 108, north of downtown, and undeveloped parcels around the northern portions of Tuttle Swamp.

D. State Protection Measures

NHDES Site Specific Permit Program

The purpose of the NHDES Site Specific Permit Program is to protect surface waters, drinking water supplies and groundwater from impacts associated with construction activities and development. The program is required under federal regulations- the EPA's Construction General Permit requiring Storm Water Pollution Prevention Plans – and authorized by state regulations under RSA 485-A:17 Terrain Alteration. The program requires water quality controls for projects disturbing more than 100,000 square feet (2.3 acres), or 50,000 square feet if any disturbance is within the protected shoreland as defined under the CSPA. The permits require implementation of stormwater Best Management Practices (BMPs) for temporary erosion and sediment control, permanent treatment of stormwater (removal of sediment, nitrogen, phosphorous, metals, etc.), and to prevent or mitigate flooding and stream bank erosion. These BMPs include the use of grassed swales, filter strips, extended-detention basins, wet ponds, bioretention cells, and vegetated buffer areas adjacent to wetlands and surface waters.

In January 2008, the state legislature adopted new requirements under RSA 485-A:17 Terrain Alteration. In 2009, NHDES developed new rules under Env-wq Alteration of Terrain. New applications are required to provide and comply with the new requirements summarized below.

Table 31. Summary of New Requirements of the 2008 Amendments Under RSA 485-A:17 Terrain Alteration

New Requirement	Description
Application Information	CSPA worksheets, photographs of the site, and identify resources including: receiving waters, 100-year floodplain, Designated Rivers, state and federally listed threatened and endangered species, Natural Heritage Bureau review and impaired surface waters
Updated Stormwater controls	Detailed soil mapping, channel protection volumes for discharges to streams and rivers, peak runoff controls for the 50-year storm, sizing of BMPs for Water Quality Volume (rather than the 2- and 20-year storm events as previously required), use of updated treatment systems (stormwater wetlands, bioretention, infiltration and filtering practices, vegetated buffers), and other Low Impact Development techniques for managing and infiltrating runoff on-site
Water Quality/Quantity	Groundwater recharge, water supply intake protection, and designated groundwater protection areas and water supply well setback areas
Antidegradation standards (Env-Wq 1507.07)	New rules also quantify requirements for compliance with the state's antidegradation standards (as defined in Env-Wq 1507.7) meaning provisions of the water quality standards that maintain and protect existing water quality and uses.

New Hampshire Stormwater Design Manual

The NHDES, with the consulting firm Comprehensive Environmental Inc. (CEI), produced a new three-volume stormwater design manual, which incorporates Low Impact Development methods and better site design techniques, stormwater management design guidance, erosion and sediment control, and pollutant load reduction. The manuals include:

- Volume 1: Stormwater and Antidegradation
- Volume 2: Post-Construction Best Management Practices Selection and Design
- Volume 3: Erosion and Sediment Controls During Construction

These documents are available for viewing or download from the NHDES website at http://des.nh.gov/organization/divisions/water/stormwater/manual.htm.

New Hampshire Water Quality Standards: Numeric Nutrient Criteria for the Great Bay Estuary

Water quality standards are goals and criteria for measuring the health of New Hampshire's surface waters. Standards consist of three parts: designated uses, numerical or narrative criteria to protect the designated uses, and antidegradation policies – which aim to maintain existing high quality water. There are six designated uses for freshwaters, and seven for tidal waters as follows: aquatic life, fish consumption, shellfish consumption (tidal only), drinking water supply after adequate treatment, primary contact recreation (swimming), secondary contact recreation (boating), and wildlife. Criteria are established by state statute (RSA 485-A) and by administrative rule.

Every two years, under the federal Clean Water Act, each state is required to submit two surface water quality documents to the US Environmental Protection Agency (EPA). The Section 305(b) report describes the quality of the state's surface waters and an analysis of the extent to which surface waters support designated uses. The Section 303(d) List includes all surface waters that are: 1) impaired or threatened by a pollutant; 2) are not expected to meet water quality standards within a reasonable time even after application of best management practices; 3) require the development and implementation of a comprehensive water quality study (Total Maximum Daily Load) setting limits designed to meet water quality standards.

Total Maximum Daily Load (TMDL) refers to the calculation of the maximum amount of a pollutant that a water body can receive and still attain or maintain water quality standards for its designated uses. It is a plan that identifies the pollutant reductions needed and describes a strategy to achieve those reductions in order to restore water quality. The process used to identify total maximum daily load is to identify the problem pollutants, establish the water quality goals or target values needed to achieve water quality standards, identify the specific sources contributing to the pollutants of concern, and assign a specific load allocation to each pollutant source. This is followed by ongoing monitoring and compliance activities.

The NH DES has developed numeric water quality criteria for the Great Bay Estuary.[49] Numeric nutrient criteria were needed because the state's water quality standards contain only narrative nutrient criteria to protect designated uses. Narrative standards are difficult to apply when making impairment and permitting decisions. There is general consensus that the Great Bay Estuary is starting to experience the negative effects of excess nitrogen. Increasing chlorophyll-a concentrations indicate increased algae and phytoplankton populations. Nuisance macroalgae was found to have replaced eelgrass in 5.7% of the Great Bay in 2007. Dissolved oxygen concentrations in the tidal rivers consistently fall below state standards. Eelgrass cover and biomass are declining throughout the estuary. This suite of effects prompted DES to partner with the Piscataqua Region Estuaries Partnership (PREP) in 2005 to develop numeric water quality criteria for nitrogen for the estuary. The PREP Technical Advisory Committee lead this four year effort, which culminated in proposed criteria for both the protection of eelgrass and for the prevention of low dissolved oxygen. The numeric criteria will first be used as interpretations of the water quality standards narrative criteria for NHDES Consolidated Assessment and Listing Methodology for 305(b) assessments. Later, NHDES will promulgate these values as water quality criteria in Env-WQ 1700 regulations.

[49] Philip Trowbridge, P.E., New Hampshire Department of Environmental Services, *Numeric Nutrient Criteria for the Great Bay Estuary*, June 2009.

E. Federal Protection Measures

Phase II: National Pollutant Discharge Elimination System (NPDES) Requirements

Depending upon the results of the 2010 census, Newmarket may qualify as an MS-4 community (defined as urbanized areas delineated by the U.S. Bureau of the Census) and therefore subject to the requirements of the EPA Phase 2 Non-point Pollutant Discharge and Elimination System (NPDES) program for any municipal stormwater discharges to Waters of the United States.

As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into Waters of the United States (Note: Waters of the United States, as defined by the Clean Water Act, means navigable waters and their tributaries, interstate waters, oceans out to 200 miles, and intrastate waters used for recreation or as a source of fish or shellfish sold in interstate commerce, or for industrial purposes by industries engaged in interstate commerce).

Regulated point sources under the NPDES permit program are discrete conveyances such as pipes or man-made ditches. Industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. NPDES permits contain limits on what can be discharged, monitoring and reporting requirements, and other provisions to ensure that the discharge does not hurt water quality or public health. The permit translates general requirements of the Clean Water Act into specific provisions tailored to the operations of each facility discharging pollutants.[50] In NH, the NPDES permit program is administered by the NHDES Pollutant Discharge Elimination System (NPDES) Federal Stormwater Program (Phase II).

[50] Environmental Protection Agency, National Pollutant Discharge Elimination System (NPDES), http://cfpub.epa.gov/npdes/, July 23, 2009.

1-9 AREAS OF ECOLOGICAL SIGNIFICANCE

Policy Statement

Establish new and maintain existing local, regional, state and federal partnerships to prevent the loss of significant wildlife habitat and ecosystems by implementing regulatory, educational and voluntary measures for land conservation, forest preservation, open space planning, and wise land use and growth.

A. Land Conservation Plan for New Hampshire's Coastal Watersheds (2006)

Spanning 990 square miles and 46 towns, New Hampshire's coastal watersheds contain exceptional and irreplaceable natural, cultural, recreational and scenic resources. To advance the long-term protection of these resources, the State of New Hampshire, acting through the NH Coastal Program and the Piscataqua Region Estuaries Partnership, developed a comprehensive, science-based land conservation plan for the state's coastal watersheds. The State also engaged a partnership of The Nature Conservancy, Society for the Protection of New Hampshire Forests, Rockingham Planning Commission, and Strafford Regional Planning Commission to develop the plan. The New Hampshire Charitable Foundation's Piscataqua Region supported this effort as a regional approach to setting land conservation priorities and strategies, and provided funding for the project. The overarching goal of this land conservation plan is to focus conservation on those lands and waters that are most important for conserving living resources - native plants, animals, and natural communities - and water quality in the coastal watersheds**.** The Plan is available on The Nature Conservancy website at http://www.nature.org/wherewework/northamerica/states/newhampshire/projects/art19061.html

The Land Conservation Plan for New Hampshire's Coastal Watersheds prioritizes coastal watershed areas and offers regional strategies for maintaining diverse wildlife habitat, abundant wetlands, clean water, productive forests, and outstanding recreational opportunities into the future. The Plan identifies Conservation Focus Areas and Supporting Landscapes - areas

considered to be of exceptional significance for the protection of living resources and water quality in the coastal watersheds including *(1) Forest Ecosystems, (2) Freshwater Systems, (3) Irreplaceable Coastal and Estuarine Resources, and (4) Critical Plant and Wildlife Habitat*. Each Conservation Focus Area is comprised of a Core Area that contains the essential natural resources for which the focus area was identified, with the boundary fitted to the real world of roads, forest edges, rivers and wetlands. The Supporting Landscapes are lands adjacent to and which provide support functions to the Core Focus Areas.

The Land Conservation Plan for New Hampshire's Coastal Watersheds identifies portions of three Conservation Focus Areas in Newmarket: Crommet and Lubberland Creeks (shared with Durham), Lower Piscassic River (shared with Newfields), and Squamscott River (shared with Newfields and Stratham). The following is a description of the resources of significance in each of these Core Focus Areas.

Crommet and Lubberland Creeks contains the following: a 1,390 acre unfragmented forest block; 501 acre high quality stream watershed; 9.2 miles of first order streams, 0.2 miles of second order streams and 0.6 miles of sixth order streams; 7.1 miles of estuarine shoreline along Great Bay; 1,500 acres total of coastal forest blocks; 55.3 acres of saltmarsh; 2 state threatened plant species, Black Maple and Small-crested Sedge; 10 animal species of state concern; significant wildlife habitat including coastal inland, floodplain forest, grassland, marsh and peatland; rich Appalachian oak rocky wood, an exemplary natural community and system (as identified by the NH Wildlife Action Plan); 2 wellhead protection areas; 231 acres of prime farmland and 49 acres of farmland of statewide importance; 1,816 acres of permanently protected managed forests; and 117 acres of land in public or institutional ownership.

Lower Piscassic River contains 1,720 acres of unfragmented forest block; 18,800 acres of aggregated forest blocks; 4.6 miles of first order streams, 3.6 miles of second order streams and 4.0 miles of fourth order streams; 2 state threatened plant species, Climbing Hempweed and Large Bur-reed; 4 species of animals of concern; significant wildlife habitat including grassland, marsh and peatland; an exemplary natural community and system (as identified by the NH Wildlife Action Plan), low-gradient silty-sandy riverbank system; 41.4 acres of high yield aquifer; 3 wellhead protection areas; 399.7 acres of prime farmland, and 185 acres of farmland of state importance; and 13.5 acres of permanently protected managed forest lands.

Squamscott River contains 5.4 miles of first order streams, 5.4 miles of second order streams and 4.6 miles of fifth order streams; 12.9 miles of estuarine shoreline along the Squamscott River and Great Bay; tidal rivers/streams- Squamscott River, Parting Brook, Jewell Hill Brook, Mill Brook, Rocky Hill Brook and several unnamed streams; 410 acres of saltmarsh; 2 state threatened plant species, Small Spike-rush and Tindra Alkali Grass; 4 species of animals of concern; significant wildlife habitat including floodplain forest, grassland, marsh and peatland; 4 exemplary natural community and system (as identified by the NH Wildlife Action Plan), High and low brackish riverbank marsh, mesic Appalachian oak-hickory forest and saline/brackish subtidal channel/bay bottom; 7 wellhead protection areas; 577 acres of prime farmland and 134 acres of farmland of statewide importance; and 332 acres of permanently protected managed forest lands.

Refer to Appendix B for detailed summaries of each of the Conservation Focus Areas and Supporting Landscapes.

B. New Hampshire Wildlife Action Plan

The New Hampshire Fish and Game Department collaborated with partners in the conservation community to create the state's first Wildlife Action Plan. The plan, which was mandated and funded by the federal government through the State Wildlife Grants program, provides New Hampshire decision-makers with important tools for restoring and maintaining critical habitats and populations of the state's species of conservation and management concern. The Plan is a pro-active effort to define and implement a strategy that will help keep species off of rare species lists, in the process saving taxpayers millions of dollars. The New Hampshire plan is a comprehensive wildlife conservation strategy that examines the health of wildlife. The plan prescribes specific actions to conserve wildlife and vital habitat before they become more rare and more costly to protect. The *New Hampshire Wildlife Action Plan* by the NH Fish and Game Department (2006) is available at http://www.wildlife.state.nh.us/Wildlife/wildlife_plan.htm**.** Refer to the Table 32 for a summary of natural habitat communities and protected lands and as shown on Appendix I - Areas of Ecological Significance Map and Appendix D for detailed descriptions of each habitat type.

Table 32. Habitats of Ecological Significance from the NH Wildlife Action Plan
[Source: NH Fish and Game Department (2007)]

Habitat Type	Acres	% Total Town Area
Appalachian Oak/Pine	5,685.9	62.7
Coastal Islands	2.6	0.03
Floodplain	557.3	6.1
Grasslands	664.7	7.3
Hemlock, Hardwood, Pine	29.9	0.3
Marshlands	306.6	3.4
Peatlands	290.8	3.2
Saltmarsh	171.2	1.9
Total	7,709.0	84.9

C. Newmarket Open Space Plan

The Newmarket Open Space Plan (June 2007) was prepared to guide the protection and management of Newmarket's significant open spaces, in the belief that a network of open spaces is fundamental to maintaining and enhancing the character of the community as it grows. The purposes of the Newmarket Open Space Plan (OSP) are to:

- Provide input for the Town Master Plan;
- Update the inventory of natural resources and conservation lands and other open spaces;
- Encourage and guide land protection by individuals, the Town, and conservation partners;
- Encourage regional cooperation by working with neighboring towns and other regional groups to pursue joint conservation interests;
- Ensure thoughtful expenditure of public funds, such as the Conservation Fund, Land Acquisition Bond, and other funding programs and guide the work of the Newmarket Conservation Commission and Open Space Commission; and
- Provide the basis for regulatory changes that work hand-in-hand with voluntary measures to conserve Newmarket’s natural resources and open spaces.

Recommendations from the Open Space Plan relating to water resources include:

- *Update existing and implement new land use planning tools to provide additional protection to the Aquifer Overlay District and Wellhead Protection Area*

- *Implement all feasible stormwater management practices to prevent or minimize runoff that contains contaminants and causes erosion*
- *Implement the wetland mitigation projects in Newmarket as identified in a 2003 Report to the NH Estuaries Project, and other restoration projects as opportunities and funding allow*
- *Evaluate the tidal wetlands (saltmarsh) to assess for potential designation as prime wetlands, similar to the freshwater prime wetlands designation*
- *Maintain involvement in committees related to the Lamprey River including the Lamprey River Advisory Committee and the Lamprey River In-Stream Flow Study Committee*

The Newmarket Open Space Plan also advocates for the implementation of land conservation measures as a method for protecting drinking water sources, and the protection of the quality of surface waters in the Town and the region's watersheds.

D. Grapevine Hill -Tuttle Swamp Management Plan

The Town of Newmarket in 2003 acquired and established the 160-acre Grapevine Hill-Tuttle Swamp Conservation Area with funding assistance from a variety of partners. The property is located north of Grant Road and east of Doe Farm Road and contains a 25+ acre field, 100+ acres of forest upland and wetland, and approximately 115+ acres total wetlands. The Tuttle Swamp wetland complex is the largest in Newmarket and is a designated Prime Wetland. This complex helps to preserve water quality and quantity of downstream drinking water and aquatic habitats.

Management goals and general management objectives were established in the deeds pertaining to the properties, reflecting the values of the funding agencies and inherent values of the property. NH Soil Consultants, Inc prepared a management plan [51] that identified five management objectives:

- Manage and enhance existing wildlife species and wildlife habitats.
- Manage and enhance existing natural communities.
- Maintain the view provided by the existing field.
- Enhance low impact outdoor recreation.
- Protect water quality and prime wetlands.

With its diversity of natural resources, significant wildlife habitats, special concern species, low impact recreational opportunities, and location adjacent to other large blocks of existing conservation and Town lands, this conservation area is of both local and regional significance.

E. Conserved Lands

As reported in the Newmarket Open Space Plan (2007), 1,866 acres or 20.56 percent of the town is protected as public and private conservation lands, through public and private protective easements or as dedicated open space. Conservation lands owned by the Town of Newmarket

[51] NH Soil Consultants, Inc., *Natural Resource Management Plan*, Revised Final Version, January 2005.

total approximately 362.5 acres, the largest parcels being Wiggin Farm-Tuttle Swamp (160 acres), Tuttle Swamp (58.8 acres), Piscassic River-Loiselle (45.3 acres), and Heron Point Sanctuary (30 acres).

Other conservation lands are owned or for which easements are held include: the Great Bay Resource Protection Partnership (>600 acres), NH Fish and Game (242.4 acres), The Nature Conservancy (176.6), and Southeast Land Trust of New Hampshire (20.0). These town-owned and other conservation lands contain critical water resources including extensive wetlands, floodplains, streams and rivers, and riparian and wildlife habitat.

The Newmarket Open Space Plan reports the following areas as having key natural resources identified as high priority for protection through land conservation efforts:

- Town drinking water sources: Newmarket Plains Aquifer, wellhead protection areas, Lamprey and Piscassic Rivers, and Follet's Brook (identified by Town as priority)
- Floodplains of the Lamprey and Piscassic Rivers (identified by Town as a priority)
- Prime wetlands (identified by Town as a priority)
- Great Bay Estuary (PREP, NH Coastal Program, NH Fish and Game, The Nature Conservancy, Great Bay Resource Protection Partnership)
- Highest quality wildlife habitat (NH Fish and Game, Wildlife Action Plan)
- Ecologically significant areas (NH Coastal Program, The Nature Conservancy, and partners)
- Large unfragmented blocks of forests and farmland (Town with State and other partners)

1-10 REGIONAL AND WATERSHED PLANNING

Policy Statement

In partnership with local, regional, state and federal partners, implement strategies to address sustainability of shared water, land and air resources.

A. Lamprey River Advisory Committee (LRAC)

The Lamprey River Advisory Committee (LRAC) is a citizen's advisory committee established to manage the Lamprey River under the State's Rivers Management and Protection Program administered by the New Hampshire Department of Environmental Services (NHDES). The rural designated river segment flows through the Towns of Epping, Lee and Durham. Representatives from Newmarket and Epping were added when these communities elected to join Lee and Durham in the federal Wild and Scenic River study of the Lamprey River. LRAC members are nominated by the governments of those towns and then are appointed by the Commissioner of the NHDES for a three-year term. There are a minimum of seven members on the committee, all serving as volunteers, representing the interests of local government, business, agriculture, conservation interests, recreation, and riparian landowners. The role of the LRAC is to develop and implement a river management plan, review and comment on local development projects within the river corridor, and advocate for local water and resource protection initiatives.

Currently in 2009, interested residents in the Lamprey River watershed will be preparing nomination documents and letters of support to include additional reaches of the Lamprey River for consideration by the DES Commissioner and the NH Legislature for inclusion in the Rivers Management and Protection Program.

As required upon designation, the LRAC developed *The Lamprey River Management Plan*, which was completed in 1995 and updated in 2007. The primary role of the Committee is to advise communities and NHDES in development and implementation of the river management

plan. The plan addresses water quality and flow, ecological resources, recreation, and historical resources. It contains recommendations for regional protection efforts which Newmarket should consider when developing its policies. One of the principal goals is to encourage communities to adopt a septic system setback distance of 150 feet along the Lamprey River and its tributaries. Currently, Newmarket uses a 75 feet setback along the Lamprey River, and 150 feet along the Piscassic River and Follett's Brook. Again, relatively minor portions of town in the western and eastern sides of the town drain directly to the Lamprey River, so adoption of this setback would affect limited areas.

Lamprey River Management Plan

The Lamprey River Management Plan identifies the following goals for protection of the river and its resources:

- Maintain a high quality of water in the Lamprey River, consistently achieving or exceeding Class B standards for the health and enjoyment of all species.
- Maintain a viable quantity of water in the river during all seasons sufficient to support and sustain the river's ecological and recreational resources, while considering the need for agricultural and municipal use.
- Work with and build upon existing inventories and conservation plans that encompass the Lamprey River watershed.
- Restore and protect the ecological functions and values of the lower Lamprey River watershed that are critical to wildlife and humans.
- Protect significant lands along the Lamprey and adjacent areas that support the ecological health of the river and its tributaries.
- Continue to work with municipalities and landowners to foster landowner interest in permanent conservation of lands within the Lamprey River corridor.
- Continue to research and make accessible to the public the history of the Lamprey River to encourage a deeper appreciation of the river's sense of place.
- Improve and increase non-motorized recreational opportunities on and along the Lamprey River in the four LRAC towns.
- Ensure that river protection goals are adequately considered during project design and review at local, state and federal levels
- Cultivate stewardship and appreciation for the river by informing and educating the public.

LRAC Land Protection Effort

The Lamprey River Land Protection effort began with identifying all properties along the river, their owners, and their predominant land uses. This inventory was conducted largely by the Lamprey River Advisory Committee (LRAC) as part of the Wild and Scenic River study. Partnering with towns, land trusts and other organizations, the LRAC has participated in the conservation of 20 properties totaling 1,072 acres and 7.5 miles of river frontage. As the LRAC land protection campaign developed, funding from the National Park Service supported a collaborative effort with the Society for the Protection of New Hampshire Forests to engage a land protection specialist to visit with owners of key properties to explain the how's and why's of voluntary land protection and to offer ongoing support for those interested in pursuing it. Through grants from the National Fish and Wildlife Foundation and prominent fishing expert Ted Williams, a Landowners Assistance program was initiated. The program covers out-of-pocket expenses such as surveys, appraisals and legal fees to landowners who donate all or part

of the value of their land or easement. The program provides incentives for landowners who otherwise might have been deterred by expenses associated with land protection.[52]

B. Lamprey River Watershed Association (LRWA)

The Lamprey River Watershed Association (LRWA), a nonprofit membership group, was formed in 1980 to promote the restoration, conservation, wise development and use of the natural resources of the Lamprey River Watershed. Conserving fish and wildlife, forests, soil and water resources along with pollution abatement are key goals of the Association. Through education and research, the LRWA works to increase the understanding among citizens about the importance of water and land conservation in the watershed, and support watershed-wide water quality monitoring, stewardship, and educational activities. The LRWA works in partnership with other conservation organizations and citizen groups to maintain or improve the natural health and beauty of the watershed, and communicate and coordinate information on issues throughout the watershed, including regulatory and policy issues. The LRWA and Lamprey River Advisory Committee (LRAC) organizations often collaborate in efforts to enhance protection of the Lamprey River. The Lamprey River Watershed Association (LRWA) also distributes several newsletters a year to keep landowners aware of the LRAC's ongoing interests in land protection and about support available to them for conserving their land.

C. Southeast Watershed Alliance

In July 2009 the Governor signed SB168[53] establishing the Southeast Watershed Alliance with the primary focus to reduce excess levels of nutrients in New Hampshire estuaries and thereby improving and protecting water quality. The Alliance's purposes are to:

- create better municipal, intermunicipal, and regional planning and coordination relative to wastewater and stormwater management, water quality and water supply planning, and land use;
- establish a regional framework for coastal watershed communities, regional planning commissions, the state, and other stakeholders to collaborate on planning and implementation measures to improve and protect water quality and more effectively address the challenges of meeting clean water standards, particularly with respect to nutrients pollution;
- encourage coastal watershed municipalities, the state, and other stakeholders, individually and in collaboration with one another, to plan, implement, and invest in wastewater, stormwater, and land use planning and management approaches that protect the water quality, natural hydrology, and habitats of the state's coastal resources and associated waters and that advance the state's economic growth, resource protection, and planning policy, established in RSA 9-B.

[52] Lamprey River Advisory Committee, *Land Conservation*, http://www.lampreyriver.org/, July 23, 2009.
[53] Chapter 220, *An ACT establishing the Southeast Watershed Alliance*, SB 168-FN – Final Version, http://www.gencourt.state.nh.us/legislation/2009/SB0168.html, July 24, 2009.

The Town of Newmarket, as a coastal community, is invited to the organizing meeting of the Alliance on October 1, 2009 and is eligible to be a member of the Alliance, by a vote of its governing body. This is a new intergovernmental venue that provides an opportunity for upstream and downstream communities to work together to steward water resources. SB168 expressly prohibits the construction of a regional outfall that transfers water out of the Great Bay estuary watershed directly into the Gulf of Maine absent legislation specifically authorizing it to do so.

1-11 RECOMMENDATIONS

This section of the chapter is designed to guide policy-makers during their decision making process. The recommendations discussed here have been put together with input from the Water Resources Chapter Work Group and the Newmarket Planning Board. The implementation strategy incorporates each recommendation and places it in three estimated timelines in which to achieve the goals of the plan. Short Term projects would be implemented within the first 2 years. Intermediate Term projects would be implemented within 2-5 years and Long Term projects are those considered for implementation 5 years or longer.

A. Surface Water Resources

SW1 Broaden the use of the current septic system setback requirement of 150 feet for Class A waters, to include all perennial streams and surface waters associated with the Follett's Brook, Piscassic River and Lamprey River watersheds and the Great Bay.

Implementation Strategy: Short Term

SW2 A. Revise the current subdivision regulations, site design regulations and zoning ordinances to include requirements for proper erosion control and stormwater runoff Best Management Practices (BMPs), including Low Impact Development (LID), for all major residential developments and commercial developments. BMPs should be consistent with NH DES Alteration of Terrain requirements and a specific technical manual (i.e. NHDES Stormwater Manual, Volumes I, II and III) adopted by the town for implementation.

B. Detain and treat stormwater onsite and provide erosion and sedimentation control for any new development. The volume and rate of runoff leaving a site in the post-development condition should not exceed the volume and rate of runoff leaving a site in the pre-developed condition.

C. Ensure that water quality enhancement methods are included in all storm water drainage designs.

Implementation Strategy: Short Term

SW3 Encourage implementation of the open space conservation plan for some of the higher priority land areas identified by the Great Bay Resource Protection Partnership between The Nature Conservancy and the Conservation Commission along New Road and Lubberland Creek. Work with State agencies and non-profit organizations that have an interest in protecting these areas. Preserving these large land areas along New Road as open space could have significant benefits in protecting the water quality of the Great Bay. Preservation of open space may allow for local passive recreation areas, and help to maintain the rural character of our community. If not protected, these lands will be subject to increasing development pressures, particularly residential development, which may result in higher municipal service costs and a negative fiscal impact.

Implementation Strategy: Short Term

SW4 Consider establishing a Water and Sewer Utilities Advisory Committee or a similar citizens advisory committee to assist in the role of evaluating the hydraulic and treatment capacity of the wastewater treatment facilities, including pumping stations, as a high priority to minimize overflows and/or treatment by-passes to the Lamprey River during storm events.

Implementation Strategy: Long Term

SW5 – Initiate studies to evaluate feasibility of upgrading the hydraulic and treatment capacity of wastewater systems.

Implementation Strategy: Long Term

B. <u>Wetlands</u>

W1 Wetlands and vernal pools are recognized as important natural resources that contribute to water quality and provide wildlife habitat. The Conservation Commission should continue to encourage preservation of vernal pools as part of their review process for subdivision and site plan review applications. Incorporate a definition for “vernal pool” and requirements for their conservation in the zoning ordinance and subdivision regulations.

Implementation Strategy: Intermediate Term

W2 Strengthen the buffer requirements in the zoning ordinance by adopting a statement of purpose and intent and describe the functions and values buffers provide.

Implementation Strategy: Intermediate Term

W3 Require infiltration to be performed on all development sites to maintain hydrologic function and recharge of groundwater, aquifers, stream baseflow and wetland hydrology.

Implementation Strategy: Short Term

W4 Inventory and develop a management plan for invasive species, particularly in the Follett’s Brook watershed, recognized priority conservation areas, prime wetlands, the Lamprey River and Great Bay watersheds. Coordinate this effort with The Nature Conservancy’s invasive species group.

Implementation Strategy: Long Term

C. Flood Management

FM1 Revise current subdivision and site design regulations to clarify that post-development peak flow rates will not exceed predevelopment flow rates for the 2-, 10-, 25- and 50-year storm events.
Implementation Strategy: Short Term

FM2 Revise subdivision and site design regulations to require developers proposing any new large developments to conduct a hydrologic analysis to evaluate the cumulative effect of how additional impervious areas in the contributing drainage area might affect the timing and magnitude of peak flow conditions downstream. This analysis will include a review of the flow capacity of existing downstream drainage or conveyances structures (i.e., culverts, bridges, and swales).
Implementation Strategy: Short Term

FM3 Incorporate results of the drainage study of Exeter Street (The Bowl) into the Master Plan.
Implementation Strategy: Short Term

FM4 Develop partnerships with communities in the Lamprey River and Piscassic River watersheds to address the effects of stormwater management and flooding from large storm events on these drainage systems.
Implementation Strategy: Intermediate Term

FM5 Update Newmarket Hazard Mitigation Plan to include flood hazards from the spring 2006 and 2007 storm events. (SRPC will be working with the Town to update the plan in 2009).
Implementation Strategy: Short Term

D. Municipal Drinking Water Supplies

DW1 Consider establishing a Water and Sewer Utilities Advisory Committee or a similar citizens advisory committee to assist in the role of monitoring and managing the available water and sewer supply and the increasing demand for municipal water services. This committee would work closely with the Capital Improvement Committee, Water and Sewer Superintendent, Town Administrator, Planning Board and Town Council to develop conservation measures and/or consider growth management policies to guide and plan for the most effective use of the Town's water supply resources.
Implementation Strategy: Short Term

DW2 Evaluate and consider recommendations for upgrades to existing water storage and distribution systems.
Implementation Strategy: Intermediate Term

DW3 Based on findings of recent well yield exploration studies, consider a Town water management policy to address future increases in water.

Implementation Strategy: Short Term

DW4 Inventory and evaluate sources and volume of water loss from the municipal drinking water distribution system.
Implementation Strategy: Short Term

DW5 Develop a water distribution and supply plan for the existing public drinking water supply system.
Implementation Strategy: Short Term

DW6 A. Provide outreach and education about the existing water conservation plan.
Implementation Strategy: Intermediate Term

B. Evaluate the effectiveness of the water conservation plan.
Implementation Strategy: Intermediate Term

C. Explore additional ways to reduce the peak daily demand for existing municipal water users during the summer months through education and conservation practices, water conservation devices and/or other demand management measures.
Implementation Strategy: Intermediate Term

DW7 Continue obtaining conservation easements through state and federal funding programs on the remaining large, undeveloped parcels in the Wellhead Protection Area around the Bennett and Sewall wells and in the local watersheds to protect the integrity and quality of these drinking water sources.
Implementation Strategy: Short Term

DW8 Inventory and evaluate existing leaks or potential contamination issues with respect to underground and above ground storage tanks within the Wellhead Protection Area (WHPA). If problems exist, explore grant opportunities under the State Source Water Protection Program to provide financial incentives for homeowners in the Wellhead Protection Area (WHPA) of the municipal drinking water supply to convert older heating oil tanks to either propane tanks or newer tanks with spill protection provisions.
Implementation Strategy: Long Term

DW9 Provide outreach and education to homeowners in the Wellhead Protection Area (WHPA) about the importance of protecting and maintaining high water quality of the municipal drinking water supply.
Implementation Strategy: Short Term

DW10 Continue efforts to establish new municipal drinking water sources.
Implementation Strategy: Intermediate Term

DW11 Continue water quality monitoring and reporting within the Wellhead Protection Area (WHPA) of the Bennett and Sewall wells.
Implementation Strategy: Long Term

DW12 Update the 2001-2002 build-out analysis completed by Strafford Regional Planning Commission to inform future planning of public drinking water supplies, and water and sewer infrastructure needs.

Implementation Strategy: Short Term

E. Open Space, Recreation and Ecology

ORE1 Establish interpretive signage and educational programs to raise awareness of important water resources along new and existing public recreational trails. Encourage establishment of public recreational trails to provide exposure and educational experiences about water resources to the public (such as expansion of the Riverwalk).
Implementation Strategy: Intermediate Term

ORE2 Perform a bi-annual inspection and monitoring program of lands within the Aquifer Protection Overlay District.
Implementation Strategy: Intermediate Term

ORE3 Adopt regulations to prohibit state invasive species in planting listings as part of the subdivision regulations and site design regulations.
Implementation Strategy: Short Term

F. Regional and Watershed Planning

RW1 Engage regional and watershed partners to discuss sustainability of water resources and aquatic habitats.
Implementation Strategy: Intermediate Term

RW2 Engage partners and stakeholders to discuss regional and watershed-based water supply planning and management.
Implementation Strategy: Long Term

RW3 Establish a multi-disciplinary advisory committee to study long-range growth management and water resource planning for the town.
Implementation Strategy: Long Term

RW4 Become familiar with DES programs and their available resources to determine appropriate partnerships and achieve results in implementing water resource recommendations.
Implementation Strategy: Intermediate Term

1-12 IMPLEMENTATION PLAN

A. Priority Recommendations – Short, Intermediate, and Long Term

Recommendations are organized based on their priority assignment of Short, Intermediate and Long Term. Short Term projects would be implemented within the first 2 years. Intermediate Term projects would be implemented within 2-5 years and Long Term projects are those considered for implementation 5 years or longer. Refer to the following tables.

B. Management Approach

The Implementation Plan assigns a Management Approach to each Recommendation based on the scope of work to be completed, the activity type, and the products or tools that will result. Management Approaches include:

- Public Education, Outreach and Training
- Land Use Regulation and Policy
- Land and Resource Conservation
- Resource Planning and Management
- State/Local Enforcement
- Collection and Use of Data
- Regional Watershed Coordination

C. Assigned Lead

Each recommendation is assigned a lead group, staff person or department to coordinate with partners, outside groups or agencies and to guide implementation.

D. Funding Requirement

Funding is available annually from a variety of local, state, federal and nonprofit sources. It is recommended that the Town develop a database of these funding sources. A work plan should be developed for each Implementation Action including a budget. Implementation Actions can be

grouped according to topic, goals and products for inclusion in a single grant proposal (i.e. stormwater, ordinance and regulation development, outreach and education, land conservation).

Short Term Recommendations

ID	Recommendation	Management Approach	Assigned Lead
SW1	Broaden the use of the current septic system setback requirement of 150 feet for Class A waters, to include all perennial streams and surface waters associated with the Follett's Brook, Piscassic River and Lamprey River watersheds and the Great Bay watersheds.	Land Use Regulation and Policy	Planning Board
SW2	A. Revise the current subdivision regulations, site design regulations and zoning ordinances to include requirements for proper erosion control and stormwater runoff Best Management Practices (BMPs), including Low Impact Development (LID), for all major residential developments and commercial developments. BMPs should be selected from a specific technical manual adopted by the town for implementation with revisions to the subdivision regulations, site design regulations and zoning ordinances. B. Detain and treat stormwater onsite and provide erosion and sedimentation control for any new development. The volume and rate of runoff leaving a site in the post-development condition should not exceed the volume and rate of runoff leaving a site in the pre-developed condition. C. Ensure that water quality enhancement methods are included in all storm water drainage designs.	Land Use Regulation and Policy	Planning Board
SW3	Encourage implementation of the open space conservation plan for some of the higher priority land areas identified by the Great Bay Resource Protection Partnership between the Nature Conservancy and the Conservation Commission along New Road and Lubberland Creek. Work with State agencies and non-profit organizations that have an interest in protecting these areas. Preserving these large land areas along New Road as open space could have significant benefits in protecting the water quality of the Great Bay. Preservation of open space may allow for local passive recreation areas, and help to maintain the rural character of our community. If not protected, these land areas will be subject to increasing development pressures, particularly residential development, which typically results in higher municipal service costs and a negative fiscal impact.	Land and Resource Conservation	Open Space Committee and Conservation Commission
W3	Require infiltration to be performed on all development sites to maintain hydrologic function and recharge of groundwater, aquifers, stream baseflow and wetland hydrology.	Land Use Regulation and Policy	Planning Board
FM1	Revise current subdivision and site design regulations to clarify that post-development peak flow rates will not exceed predevelopment flow rates for the 2-, 10-, 25- and 50-year storm events.	Land Use Regulation and Policy	Planning Board
FM2	Revise subdivision and site design regulations to require developers proposing any new large developments to conduct a hydrologic analysis to evaluate the cumulative effect of how additional impervious areas in the contributing drainage area might affect the timing and magnitude of peak flow conditions downstream. This analysis will include a review of the flow capacity of existing downstream drainage or conveyances structures (culverts/bridges, etc)	Land Use Regulation and Policy	Planning Board

ID	Recommendation	Management Approach	Assigned Lead
FM3	Incorporate results of the drainage study of Exeter Street (The Bowl) into the Master Plan.	Collection and Use of Data	Planning Board
FM5	Update Newmarket Hazard Mitigation Plan to include flood hazards from the spring 2006 and 2007 storm events. (SRPC will be working with the town to update the plan in 2009).	Resource Planning and Management	Energy Management Director
DW1	Consider establishing a Water and Sewer Utilities Advisory Committee or a similar Citizens Advisory Committee to assist in the role of monitoring and managing the available water and sewer supply and the increasing demand for municipal water services. This committee would work closely with the Capital Improvement Committee, Water and Sewer Superintendent, Town Administrator, Planning Board and Town Council to develop conservation measures and/or consider growth control policies to guide and plan for the most effective use of the Town's water supply resources.	Resource Planning and Management	Town Council
DW3	Based on findings of recent well yield exploration studies, consider a Town water management policy to address future increases in water.	Resource Planning and Management	Town Council
DW4	Inventory and evaluate sources and volume of water loss from the municipal drinking water distribution system.	Collection and Use of Data	Water Department
DW5	Develop a water distribution and supply plan for the public drinking water supply system.	Resource Planning and Management	Water Department
DW7	Continue obtaining conservation easements through state and federal funding programs on the remaining large, undeveloped parcels in the Wellhead Protection Area around the Bennett and Sewall wells and in the local watersheds to protect the integrity and quality of these drinking water sources.	Land and Resource Conservation	Open Space Committee, Conservation Commission
DW9	Provide outreach and education to homeowners in the Wellhead Protection Area (WHPA) about the important of protecting and maintaining high water quality of the municipal drinking water supply.	Public Education, Outreach and Training	Water Department
DW 12	Update the 2001-2002 build-out analysis completed by Strafford Regional Planning Commission to inform future planning of public drinking water supplies, and water and sewer infrastructure needs.	Resource Planning and Management	Planning Board
ORE3	Adopt state invasive species listings as part of the subdivision regulations and site design regulations.	Land Use Regulation and Policy	Planning Board

Intermediate Term Recommendations

ID	Recommendation	Management Approach	Assigned Lead
W1	Incorporate a definition for "vernal pool" and requirements for their conservation in the zoning ordinance.	Land Use Regulation and Policy	Planning Board
W2	Strengthen the buffer requirements in the zoning ordinance by adopting a statement of purpose and intent and describe the functions and values buffers provide.	Land Use Regulation and Policy	Planning Board
FM4	Develop partnerships with communities in the Lamprey River and Piscassic River watersheds to address the effects of stormwater management and flooding from large storm events on these drainage systems.	Regional and Watershed Coordination	Open Space Committee, Conservation Commission
DW2	Evaluate and consider recommendations for upgrades to the water storage and distribution systems.	Resource Planning and Management	Water Department
DW6	A. Provide outreach and education about the existing water conservation plan. B. Evaluate the effectiveness of the water conservation plan. C. Explore additional ways to reduce the peak daily demand for existing municipal water users during the summer months through education and conservation practices, water conservation devices and/or other demand management measures.	Public Education, Outreach and Training	Water Department
DW10	Continue efforts to establish new municipal drinking water sources.	Resource Planning and Management	Water Department and Town Council
ORE1	Establish interpretive signage and educational programs to raise awareness of important water resources along new and existing public recreational trails. Encourage establishment of public recreational trails to provide exposure and educational experiences about water resources to the public (such as expansion of the Riverwalk Trail).	Public Education, Outreach and Training	Open Space Committee, Conservation Commission
ORE2	Perform a bi-annual inspection and monitoring program of lands within the Aquifer Protection Overlay District.	Land Use Regulation and Policy, State/Local Enforcement	Code Enforcement Officer
RW1	Engage regional and watershed partners to discuss sustainability of water resources and aquatic habitats.	Land and Resource Conservation	Conservation Commission

Long Term Recommendations

ID	Recommendation	Management Approach	Assigned Lead
SW4	Consider establishing a Water and Sewer Utilities Advisory Committee or a similar Citizens Advisory Committee to assist in the role of evaluating the hydraulic and treatment capacity of the wastewater treatment facilities, including pumping stations, as a high priority to minimize overflows and/or treatment by-passes to the Lamprey River during storm events. The committee would develop a report for submission to the Capital Improvements Plan Committee.	Resource Planning and Management	Town Council
SW5	Initiate studies to evaluate feasibility of upgrading the hydraulic and treatment capacity of wastewater systems.	Resource Planning and Management	Water Department
W4	Inventory and develop a management plan for invasive species, particularly in the Follett's Brook watershed, recognized priority conservation areas, prime wetlands, the Lamprey River and Great Bay. Coordinate this effort with The Nature Conservancy's invasive species group.	Resource Planning and Management	Conservation Commission, Open Space Committee
DW8	Inventory and evaluate existing leaks or potential contamination issues with respect to underground and above ground storage tanks within the Wellhead Protection Area (WHPA). If problems exist, explore grant opportunities under the State Source Water Protection Program to provide financial incentives for homeowners in the Wellhead Protection Area (WHPA) of the municipal drinking water supply to convert older heating oil tanks to either propane tanks or newer tanks with spill protection provisions.	Collection and Use of Data, Resource Planning and Management	Water Department
DW11	Continue water quality monitoring and reporting within the Wellhead Protection Area (WHPA) of the Bennett and Sewall wells.	Collection and Use of Data	Water Department
RW2	Engage partners and stakeholders to discuss regional and watershed-based water supply planning and management.	Resource Planning and Management	Strafford Regional Planning Commission
RW3	Establish a multi-disciplinary advisory committee to study long-range growth management and water resource planning for the town.	Resource Planning and Management	Planning Board
RW1	Become familiar with DES programs and their available resources to determine appropriate partnerships and achieve results in implementing water resource recommendations.	Land and Resource Conservation	Conservation Commission

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1-14 APPENDICES

APPENDIX A. **Annual and Monthly Yield Statistics for the Sewall and Bennett Wells**
APPENDIX B. **Conservation Focus Areas and Supporting Landscapes from *The Land Conservation Plan for New Hampshire's Coastal Watersheds* (2007)**
APPENDIX C. **Vernal Pool Species of New Hampshire**
APPENDIX D. **NH Wildlife Action Plan Habitats of Ecological Significance**
APPENDIX E. **Potential Hazards from the Newmarket Hazard Mitigation Plan (2006)**
APPENDIX F. **Lamprey River Watershed Map**
APPENDIX G. **Water Resource Map**
APPENDIX H. **Wetlands Map**
APPENDIX I. **Areas of Ecological Significance Map**

APPENDIX A. Annual and Monthly Yield Statistics for the Sewall and Bennett Wells

2007						
Bennett Well			**Sewall Well**			
Month	**Ave/gals/day**	**Monthly/gals**	**Ave/hrs/day**	**Ave/gals/day**	**Monthly/gals**	**Ave/hrs/day**
January	197,230	6,114,040	16.6	242,580	7,520,060	16.9
February	202,460	5,669,000	17.7	243,580	6,812,850	17.4
March	198,590	6,156.270	17.4	238,660	7,398,430	17.0
April	239,520	7,185,650	17.5	247,000	7,409,990	17.6
May	259,060	8,030,800	18.9	259,550	8,045,940	18.5
June	263,160	7,894,900	18.9	268,870	8,066,200	19.2
July	213,460	6,617,330	18.1	248,570	7,705,600	17.7
August	237,890	7,374,200	17.5	300,430	9,313,400	17.1
September	237,510	7,125,200	17.4	323,040	9,691,300	17.3
October	203,980	6,323,500	15.0	268,950	8,337,500	14.9
November	193,940	5,818,200	14.3	259,300	7,719,000	14.0
December	194,600	6,035,400	14.3	258,190	8,003,900	14.0
Total		**80,344,490**			**96,024,170**	
Total for 2007 = 176,368,660 gallons						
2006						
Month	**Ave/gals/day**	**Monthly/gals**	**Ave/hrs/day**	**Ave/gals/day**	**Monthly/gals**	**Ave/hrs/day**
January	148,470	4,602,200	16.5	289,660	8,979,400	15.8
February	149,900	4,197,300	16.4	298,930	8,369,900	16.0
March	148,320	4,597,900	16.2	296,580	9,194,000	15.9
April	151,900	4,559,700	16.6	303,540	9,106,300	16.3
May	184,660	5,724,600	16.9	278,160	8,622,980	16.6
June	206,280	6,188,370	17.4	273,030	8,190,820	17.1
July	204,710	6,346,030	17.1	270,910	8,398,060	16.7
August	209,920	6,290,500	17.5	278,350	8,628.980	17.1
September	198,380	5,951,250	17.2	275,050	8,251,550	16.9
October	200,140	6,202,220	17.4	278,830	8,643,630	17.1
November	190,760	5,722,910	16.7	267,050	8,011,420	16.4
December	191,780	5,945,330	16.8	269,150	8,343,580	16.5
Total		**66,328,310**			**102,740,620**	
Total for 2006 = 169,068,930 gallons						

APPENDIX B. Conservation Focus Areas and Supporting Landscapes from The Land Conservation Plan for Hampshire's Coastal Watersheds (2007)

APPENDIX C. Vernal Pool Species of New Hampshire

Species	Description
Amphibians	
Wood Frog	Terrestrial except during the breeding season; live in woodlands, where they forage for food among leaves and debris on the forest floor; hibernate in winter under rocks, moss, leaf litter, or in rotting logs and stumps; often the first amphibians to emerge in spring, at which time large numbers of males and females migrate to breeding sites during the first warm rains (from late March to late April); breeding completed within a couple of weeks, after which adults return to the woods; eggs hatch into tiny tadpoles in about three weeks, depending on water temperature; tadpoles grow and eventually metamorphose into juveniles after an average of 67 days; juveniles gather in large groups along the shore of the pool before dispersing into surrounding woodlands.
Spring Peeper	May use vernal pools for breeding, in addition to any pond, ditch, or other small water body, may breed in early spring.
Green Frog or Bullfrog	May seek out vernal pools to feed on eggs and tadpoles in late summer; do not breed in temporary water bodies, as their tadpoles need to stay in the water for over a year before they reach metamorphosis; tadpoles do not metamorphose into terrestrial forms until they are three years old.
Spotted, Jefferson and Blue-spotted Salamander	Various species breed in vernal pools; Spotted, Jefferson's, and blue-spotted salamanders arrive between mid-March and late April; known as "mole" salamanders because of their subterranean lifestyles, spend most of their lives in underground rodent burrows and tunnels and crevices under rocks and other debris; adults emerge from underground and migrate to vernal pools during the first warm, rainy evenings of spring; although breeding season may last a few weeks, males and females in any given pool complete courtship, mating, and egg-laying in just a few days; females attach their eggs to branches, logs, and other underwater structures, after which they leave the pools and go back underground for the rest of the year; mole salamander egg masses look like clear or opaque and made up of many eggs, each with a tiny dark embryo which hatch in three to five weeks, depending on water temperature. Larvae metamorphose by late summer, and leave the pools to live underground in surrounding uplands.
Marbled Salamander	Extremely rare in New Hampshire, having been found in only a few places in the southern part of the state; lives underground most of the year, but adults breed in the fall, selecting dry autumnal pools to breed and lay eggs; males leave dry pools soon after breeding, while females stay behind to guard and incubate the eggs, when rains fill the breeding pools, females leave; eggs hatch into aquatic larvae, which will remain in the pool until they metamorphose in late fall or early spring.
Eastern Spotted Newt and Four-toed Salamander	Newts typically live in permanent water, such as ponds and lakes; larvae metamorphose into terrestrial juveniles known as "red efts," which travel on land for two to seven years before returning to water to breed; some may select a vernal pool in which to transform into their aquatic adult phase; four-toed salamanders do not lay their eggs in pools, but attach them to rocks, logs, or moss clumps directly over the water; hatching larvae fall from the egg mass directly into the pool.
Invertebrates	
Fairy Shrimp	Small crustaceans that look like tiny shrimp and the only species that are unique to these habitats in our area; measuring anywhere from 1/2 to 1 inch long, they swim along just below the water's surface; lay their eggs in the soil and leaf litter on the bottom of the pool as the pools dry up; adults die off when the pools dry completely, and remaining eggs are dormant until the pools fill again the following spring.
Reptiles	
Spotted, Blanding's and Wood Turtles	May use pools during the breeding season of wood frogs and mole salamanders; species wander extensively on land searching for food during the spring, summer, and fall; seek out vernal pools in early spring to prey on amphibian and invertebrate eggs and larvae; relatively deep vernal pools may serve as over-wintering sites for some Blanding's and spotted turtles.

APPENDIX D. NH Wildlife Action Plan Habitats of Ecological Significance

Habitat	Description
Appalachian Oak/Pine	Appalachian oak-pine forests are found mostly below 900 ft. elevation in southern New Hampshire. These forests include oak, hickory, mountain laurel, and sugar maple, and are typically associated with warmer and drier climatic conditions. Appalachian oak-pine forests are fire-influenced landscapes with nutrient-poor, dry, sandy soils. They are home to hognose snakes, whip-poor-wills, silver-haired bats and other species of concern. Intense development has dramatically reduced the area of this forest type, which comprises some 10% of the state's total land area, in New Hampshire's southern tier.
Floodplain Forest	Floodplain forests occur in valleys adjacent to river channels and are prone to periodic flooding. Also referred to as riparian forests, they support diverse natural communities, protect and enhance water quality by filtering and sequestering pollution, and control erosion and sediment. Their rich soils have been used in agriculture for centuries; so many floodplains are no longer forested wildlife habitat.
Grassland	Extensive grasslands are defined as areas greater than 10 hectares (~ 25 acres) that are dominated by grasses, wildflowers, and sedges with little shrub or tree cover. Some examples include hayfields, pastures, and cropland (cornfields and other row crops). Grasslands in NH must be mowed to prevent them from becoming shrublands or forests. Only 8% of NH grasslands are currently under conservation easements.
Hemlock, Hardwood, Pine Forest	Hemlock-hardwood-pine forests are transitional forests, occurring between hardwood conifer and oak-pine forests. This common forest type is comprised of dry, sandy soils with red oak and white pine. When hemlock-hardwood-pine forests have been burned regularly over time, they may be able to support a pitch-pine sand plains system.
Marshland	Emergent marsh and shrub swamp systems have a broad range of flood regimes, often controlled by the presence or departure of beavers. This system, which is an important food source for many species, is often grouped into three broad habitat categories: wet meadows, emergent marshes, and scrub-shrub wetlands. Marsh and wetlands filter pollutants, preventing them from getting into local streams, and help hold water to reduce flooding.
Peatland	Peatlands have water with low nutrient content and higher acidity caused by limited groundwater input and surface runoff. Conservation of the 11 different natural communities that comprise peatlands is vital to the continued existence of many rare plant and wildlife species in New Hampshire. The most challenging issues facing peatlands habitat are development; altered hydrology (amount and flow of water); non-point source pollutants such as road salt, lawn fertilizers, and pesticides; and unsustainable forest harvesting.
Saltmarsh	Salt marshes are grass-dominated tidal wetlands existing in the transition zone between ocean and upland. They are among the most productive ecosystems in the world and are nurseries for several fisheries. Salt marshes also help protect coastal areas from storm surges.

APPENDIX E. Potential Hazards from the Newmarket Hazard Mitigation Plan (2005)

APPENDIX F: Lamprey River Watershed Map

APPENDIX G: Water Resource Map

APPENDIX H: Wetlands Map

APPENDIX I: Areas of Ecological Significance Map